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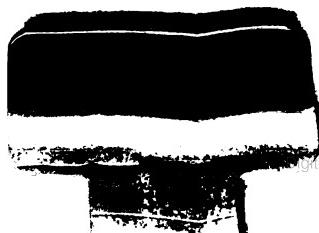
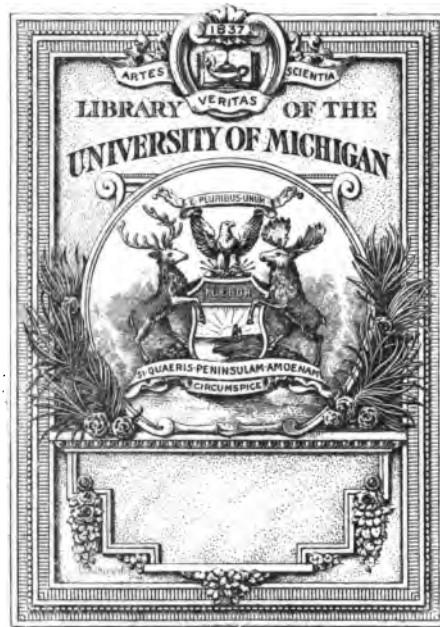
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# REVIEW

1897

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the Massachusetts Institute of Technology.

ARTHUR A. NOYES, Editor.

HENRY P. TALBOT, Associate Editor.

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# REVIEW OF AMERICAN CHEMICAL RESEARCH.<sup>1</sup>

VOL. III. NO. I.

ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

## INORGANIC CHEMISTRY.

BY HENRY FAY, REVIEWER.

**On the Diffusion of Sulphides through Steel.** By E. D. CAMPBELL. *Am. Chem. J.*, 18, 707-719.—In a previous paper (*Am. Inst. Min. Eng.*, 23, 621), the author has described the rapidity with which sulphide of iron diffused through steel at a bright red heat. Bars of soft steel of the dimensions  $2.5 \times 5 \times 15$  cm., and the ordinary fused sulphide of iron were used. Holes 12 mm. in diameter and 30 mm. deep were filled with 10 grams iron sulphide, and an iron plug was driven in. After heating to a bright red heat in a muffle, the bar was allowed to cool slowly. The hole was then found nearly empty, and drillings taken near the hole showed on analysis no increase in sulphur, while the scale formed at the surface by oxidation showed 2.6 per cent. of sulphur. These experiments were taken up later, but a different specimen of iron sulphide was used. Though carried out in exactly the same manner, no diffusion was found to take place. A Hoskins muffle furnace was arranged so that the sulphide in the hole could be watched during the heating. Using the normal sulphide of iron, FeS, in both open and plugged holes, the sulphide was seen to melt, but no diffusion took place. A subsulphide, approximately of the composition,  $\text{Fe}_2\text{S}$ , was next made, and a bar 5 cm. long was prepared with two holes equally distant from the center and ends; each hole was filled with 12 grams of the sulphide. The bar was placed in the furnace on platinum covered supports, and heated to a bright red heat in an oxidizing atmosphere for about two hours. No diffusion was noticed. An oxysulphide of iron was then prepared and found to diffuse quite rapidly. In from 10-15 seconds from the time the sulphide was observed to begin

<sup>1</sup>This Review, which for two years past has appeared in the *Technology Quarterly* and as a separate publication, will hereafter be published only in this journal and in the *Technology Quarterly*. Copies of the two preceding volumes may be obtained by addressing the Librarian of the Massachusetts Institute of Technology, Boston, Mass.

diffusing, diffusion appeared to be complete and the greater part of the sulphur had been oxidized in the air at the temperature of the experiment. To show that the oxysulphide diffuses the whole length of the bar, a bar 10 cm. long was prepared, and a hole was drilled 12 mm. from the end. At the further end a strip of asbestos was placed, held in position by a wire passing around the bar. The temperature was brought to a bright red heat, and after cooling the portions of asbestos in contact with top and bottom were found black from oxide of iron, due to the complete diffusion. Cuprous sulphide was found not to diffuse at all, but mixed with oxysulphide of iron it was carried along with it. Nickel sulphide does not diffuse alone, nor when mixed with iron oxysulphide. The author explains the phenomenon by assuming that oxysulphide of iron is an extremely mobile liquid at the temperature of the experiment, and that steel is probably porous at the high temperature, so that diffusion can take place; the diffusing substance would readily be absorbed by any porous absorbent material, such as asbestos or scale. Cuprous sulphide he considers is not sufficiently mobile to be drawn through the fine pores of the steel. Gravity affects the diffusion, showing that the diffusion takes place in the liquid, and not in the gaseous state.

**On the Influence of Heat Treatment and Carbon upon the Solubility of Phosphorus in Steels.** By E. D. CAMPBELL AND S. C. BABCOCK. *Am. Chem. J.*, 18, 719-723.—This work was undertaken to see whether heat treatment and carbon influence the solubility of phosphorus, and to determine whether chemical evidence could be obtained to prove the existence of phosphorus in steels in different modifications. For this purpose samples were taken containing varying percentages of carbon, and subjected to different heat treatments. The phosphorus was determined in each in an annealed sample, in a hardened one, and in a normal portion, as it came from the mill. In each sample a determination was made of the total phosphorus, of the phosphorus soluble and insoluble in neutral mercuric chloride, and of that insoluble in neutral mercuric chloride but soluble in 4 per cent. hydrochloric acid. The phosphorus soluble in mercuric chloride was determined by shaking 5 grams of steel with 35 grams of mercuric chloride and 130 cc. of water. The filtrate was examined for phosphorus by adding 10 cc. of ferric chloride solution, in which the phosphorus had been previously determined, and 4 grams sodium acetate, precipitating as basic acetate, dissolving and reprecipitating with ammonium molybdate. The portion insoluble in mercuric chloride was placed, together with the mercury, in a boat in a combustion tube, and after the mercury had been volatilized, the phosphorus was determined in the residue. From the table of results given, the following conclu-

sions are drawn: 1. With very low percentage of carbon, the effect of heat treatment upon the solubility of phosphorus is slight. Probably if carbon were entirely absent there would be no effect. 2. With increase of carbon the effect of hardening is to decrease the solubility of the phosphorus. 3. With a high percentage of carbon the solubility is increased by slow cooling. The author considers that these facts indicate the probable formation at a high temperature of a difficultly soluble compound of iron with carbon and phosphorus, which on slow cooling passes into an easily soluble one.

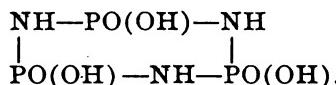
**A Pure Carbide of Iron.** By E. D. CAMPBELL. *Am. Chem. J.*, 18, 836-847.—The investigation was undertaken to see whether a purer carbide of iron than any heretofore isolated could be obtained, and to determine whether a formula as simple as  $\text{CFe}$ , should be assigned to it. The steel used in the work was one containing 1.29 per cent. of carbon. It was cut into bars and the bars carefully annealed by packing between layers of sheet asbestos; below these was a layer of crushed charcoal, and above a mixture of one part of charcoal to five of wood ashes. The muffle in which the whole was placed, was brought to a bright red heat, the fires banked, and allowed to cool slowly. After cooling, the scale was removed by grinding on an emery wheel, and the bars were cut into strips 15 cm. long, 15 mm. wide, and 5 mm. thick. Twelve of these bars were hung on a ring of copper wire in a 4 per cent. solution of hydrochloric acid and connected with the positive pole of four storage batteries. The negative pole was a platinum cylinder suspended in a porous cup placed in the center of the circle of bars. A current of one ampere was allowed to act over night, and in the morning the residue adhering to the bars was removed with a brush of aluminum wires. The carbide was washed with potassium hydroxide and water, and the lighter portions decanted off. The carbide remaining was washed with alcohol and ether, the dried product consisting of a bright steel gray powder made up of thin plates or scales of specific gravity 6.944. After 29 electrolyses 575.8 grams of steel were dissolved and 55.1 grams of carbide obtained. On analysis the substance gave 6.646 and 6.625 per cent. carbon, 93.25 per cent. iron, and 0.026 per cent. phosphorus. The carbide is slowly but completely converted into ferric oxide by oxidation in moist air, and is completely soluble in moderately concentrated hydrochloric acid. An examination of the gases evolved on treatment with acid showed them to be hydrogen, ethane, and the unsaturated hydrocarbon butylene, probably mixed with a little dibutylene. Butane probably remained in the solution in the generating flask. The author considers it not improbable that iron and carbon may form a series of ferrocarbons of the general formula  $\text{C}_n\text{Fe}_{,n}$ , analogous to the hydro-

carbons  $C_nH_{2n}$ , in which a group of three bivalent iron atoms would replace two hydrogen atoms of the unsaturated hydrocarbon. On treatment with acids the corresponding hydrocarbon would be set free, and would be partly converted into the corresponding saturated hydrocarbon by secondary reactions.

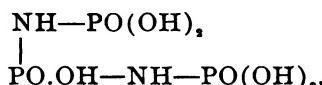
**The Alkali Trihalides.** By CHARLES H. HERTY AND HOMER V. BLACK. *Am. Chem. J.*, 18, 847-849.—It has been previously shown by Herty that the so-called compounds  $PbI\bar{C}l$ ,  $PbI_2\cdot 2PbCl_2$ , and  $PbI_2\cdot 5PbCl_2$ , are isomorphous mixtures of lead iodide and lead chloride. To determine whether the alkali trihalides are of the same nature, rubidium dibromiodide was prepared by adding bromine to rubidium diiodide. On evaporation three separate crops of crystals, similar in appearance, were obtained, and each crop was analyzed, giving results which indicated that they were all of the same composition, namely, that represented by the formula  $RbBr_2I$ . They are therefore not isomorphous mixtures.

**On Trimetaphosphimic Acid and Its Decomposition Products.** By H. N. STOKES. *Am. Chem. J.*, 18, 629-663.—In a previous paper the author has shown that by shaking with water an ethereal solution of Liebig's phosphorus chloronitride,  $P_3N_3Cl_6$ , an acid is obtained which has the empirical formula  $P_3N_3O_6H_6$ , and to which he gave the name trimetaphosphimic acid. He regarded the acid as a metaphosphoric acid ( $HPO_3$ )<sub>n</sub>, in which one-third of the oxygen is replaced by an equivalent number of imido (NH) groups. The acid is best prepared by agitating 30 grams of phosphorus chloronitride dissolved in 150 cc. alcohol-free ether with a solution of 110 grams of sodium acetate in 200 cc. of water. After 15 hours well formed crystals of the sodium salt appear, and after 70-80 hours the reaction is complete. The constitution of trimetaphosphimic acid depends upon that of the phosphorus chloronitride. The structural formula of the latter has not been definitely established, but it is reasonably certain that the phosphorus atoms are joined by nitrogen, otherwise the formation of hydrazine might be expected. It is quite likely, also, that chlorine is not united to nitrogen; for in this case hydroxylamine might be expected. The simplest formula meeting the requirements is one in which the nucleus consists of a symmetrical ring of three phosphorus and three nitrogen atoms. Direct replacement of chlorine would give an acid in which the grouping  $-(OH)_3P=N-$  is repeated three times in the ring, but the author considers that the labile nature of the hydrogen, as observed in many organic substances containing nitrogen, makes it not improbable that the grouping may take the tautomeric form  $-(OH)PO-NH$ . This assumption is in accordance with the facts, and explains the formation and decomposition of trimetaphosphimic acid. The acid is

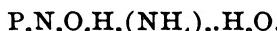
extremely soluble, uncrystallizable, and undergoes rapid spontaneous decomposition. The final decomposition products are phosphoric acid and ammonia, but the intermediate products, diimidotriphosphoric acid, imidodiphosphoric acid, and pyrophosphoric acid have been isolated. Assuming the symmetrical ring formula referred to above :



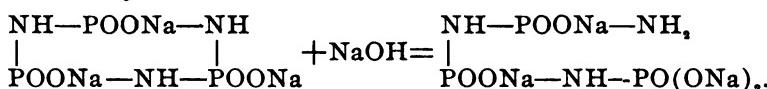
the decomposition with water takes place with the formation of ammonia and diimidotriphosphoric acid :



this again reacting with water to form ammonia and imidodiphosphoric acid :  $\text{NH} < \text{PO(OH)}_2$ , and phosphoric acid. The imidodiphosphoric acid then reacts with water to form pyrophosphoric acid and ammonia ; this reaction is shown to take place by heating the free acid with dilute acetic acid, when about 15 per cent. pyrophosphoric acid is obtained. The sodium salt of trimetaphosphinic acid,  $\text{P}_3\text{N}_5\text{O}_6\text{H}_4\text{Na}_4\cdot 4\text{H}_2\text{O}$ , was prepared by treating an ethereal solution of phosphorus chloronitride with sodium acetate. When crystallized above  $80^\circ \text{ C}$ . it contains only one molecule of water. The ammonium salt,



and the silver salt,  $\text{P}_3\text{N}_5\text{O}_6\text{H}_4\text{Ag}$ , are characteristic, and serve to identify the acid. The silver salt,  $\text{P}_3\text{N}_5\text{O}_6\text{Ag}$ , exists in two well defined forms. Its analysis serves to establish the empirical composition of the acid. One of these silver salts is white, amorphous, and soluble in ammonium nitrate, and is easily converted by this reagent into the other, which is red, crystalline, and insoluble in it. By crystallizing the tertiary sodium salt from an excess of sodium hydroxide a salt containing four atoms of sodium is obtained. The author considers it as an amido derivative of diimidotriphosphoric acid, assuming that sodium hydroxide is added directly to the molecule of the trisodium salt in this way :



Silver nitrate precipitates a salt from the tetra sodium salt, but it decomposes so readily that satisfactory analytical results could not be obtained. Diimidotriphosphoric acid forms two series of salts, in which three and five atoms, respectively, of

hydrogen are replaced. The alkali salts with three atoms of metal are neutral; those with five atoms have an alkaline reaction. The two remaining hydrogen atoms have not been replaced by metal. Imidodiphosphamic acid is probably identical with Gladstone's pyrophosphamic acid. It forms a tri and a tetra silver salt, the latter existing in two distinct forms. The acid can be distinguished from amidodiimidotriphosphoric acid by the insolubility of its magnesium salt, by its syrupy tertiary sodium salt, and by the yellow precipitate which its ammoniacal solution gives with silver nitrate.

**On Tetrametaphosphimic Acid.** By H. N. STOKES. *Am. Chem. J.*, 18, 780-789.—Tetrametaphosphimic acid can be obtained by agitating tetraphosphonitrilic chloride,  $P_4N_4Cl_8$ , dissolved in 15 volumes of alcohol-free ether with five volumes of water. Chlorhydrines are formed as intermediate products, but remain dissolved in the ether, while the free acid separates in crystalline condition. From one of the chlorhydrines an acid was obtained, but in too small amount to determine its composition. Tetrametaphosphimic acid can also be obtained in the form of its ammonium salt by agitating the chloride with aqueous ammonia or ammonium acetate. In the latter case the yield is theoretical. The free acid crystallizes with two molecules of water,  $P_4N_4O_8H_8 \cdot 2H_2O$ , which are not given off in *vacuo*. At 100° C. it loses weight at first rapidly, and then slowly, but the total loss never reaches the theoretical. Heated rapidly to 130-140° C. the loss is soon replaced by a gain, and after 30 hours at this temperature an increase of 11.15 per cent. was observed. The product consisted of unchanged acid, with ammonium phosphate and apparently pyrophosphoric acid. One hundred parts of water at 20° C. dissolve 0.64 parts of the crystallized acid. Boiling alkaline solutions cause no evolution of ammonia. It is extremely stable towards acids. Experimental data are lacking for a discussion of the constitution of this acid, as the decomposition products are extremely unstable. Presumably the phosphorus atoms in the nucleus  $P_4N_4$  are united by nitrogen atoms, but whether they constitute a ring of eight atoms cannot be decided. Three series of salts are formed,  $P_4N_4O_8H_8M^{+}_2$ ,  $P_4N_4O_8H_8M^{+}_4$ , and  $P_4N_4O_8M^{+}_8$ . The dipotassium, tetrasodium, di- and tetra-ammonium, dibarium, and tetrasilver salts are described. If an ammoniacal solution of a salt containing four atoms of metal is added to an excess of silver nitrate, a yellow flocculent precipitate forms which is insoluble in ammonium nitrate. When, however, a neutral tetrametaphosphimate is added to silver nitrate containing a slight excess of ammonia, a small amount of a nearly white flocculent precipitate forms which is soluble in ammonium nitrate on gently warming; from this solution an orange yellow crystalline substance is thrown

out on boiling for a moment. From the original filtrate a large quantity of the same salt is obtained by boiling. Each salt contains eight atoms of silver, and the crystalline salt is apparently a modification of the yellow precipitate formed in the first case. The author suggests that these salts may be regarded as corresponding to the tautomeric forms of the acid  $(\text{PN}(\text{OH}))_4$  and  $(\text{PO.NH.OH})_4$ .

**Mercuric Chlorthiocyanate.** By CHARLES H. HERTY AND J. G. SMITH. *J. Am. Chem. Soc.*, 18, 906-908.—By fractional crystallization and analysis of the different crops of crystals, the authors conclude that mercuric chlorthiocyanate is a true chemical compound, and not an isomorphous mixture of mercuric chloride and mercuric thiocyanate.

**Nickelo-Nickelic Hydrate,  $\text{Ni}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ .** By WILLIAM L. DUDLEY. *J. Am. Chem. Soc.*, 18, 901-903.—Nickelo-nickelic hydrate,  $\text{Ni}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ , was obtained in crystals by fusing metallic nickel with sodium peroxide.

**Contribution to the Knowledge of the Ruthenocyanides.** By JAMES LEWIS HOWE. *J. Am. Chem. Soc.*, 10, 981-987.—The author has tried many methods for the preparation of ruthenocyanide to ascertain the efficiency of each, has given some qualitative reactions, and has prepared and analyzed the potassium and barium salts.

**Some New Compounds of Thallium.** By L. M. DENNIS AND MARTHA DOAN, with Crystallographic Notes, by A. C. GILL. *J. Am. Chem. Soc.*, 18, 970-977.—The authors have prepared the compounds thallous trinitride,  $\text{TlN}_3$ , thallous-thallic trinitride,  $\text{TlN}_2\text{TiN}$ , thallous tellurate,  $\text{Tl}_2\text{TeO}_6$ , and thallous cyanoplatinite,  $\text{TlPt}(\text{CN})_6$ . The author calls the acid  $\text{HN}_3$ , hydro-nitric acid and its salts trinitrides. Owing to the fact that other nitrides besides those derived from this acid exist, it is far preferable in the reviewer's opinion to name the acid *hydrazoic acid*, in accordance with the proposal of its discoverer, and to call its salts *azides*.

**Reduction of Concentrated Sulphuric Acid by Copper.** By CHARLES BASKERVILLE. *J. Am. Chem. Soc.*, 18, 942-947.—The author refutes the statement of Andrews (*this Rev.*, 2, 6,) that copper is not acted upon at  $0^\circ\text{C}$ ., and not until  $86^\circ\text{C}$ . has been reached, which is above the point of dissociation of sulphuric acid. The previous work of the author has been repeated and confirmed. He also shows that, when air is absent, sulphuric acid is reduced by copper at a temperature far below  $86^\circ\text{C}$ . with formation of cupric sulphate, cuprous sulphide and sulphur dioxide.

## ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

**The Action of Sodium on Aldehyde.** By PAUL C. FREER. *Am. Chem. J.*, 18, 552-562.—When aldehyde, diluted with ether, was treated with sodium, hydrogen was evolved and a white crystalline sodium derivative, believed to have the structure  $\text{CH}_3:\text{CHONa}$ , was formed. The compound could not be analyzed, as it soon changed into a brown, sticky mass. Sodium reacted with an ethereal solution of aldehyde and benzoyl chloride. After the reaction was completed, the solvent was washed with potassium hydroxide to remove benzoic acid, dried, and evaporated in a vacuum. A thick, slightly yellow syrup, which soon became permeated with a mass of prismatic crystals, was obtained. The latter melted at  $86^{\circ}-87^{\circ}$ , had the composition  $\text{C}_{15}\text{H}_{16}\text{O}_4$ , and were soluble in alcohol, ligroin, benzene, and chloroform. By treatment with water at  $100^{\circ}$  in a closed tube, the compound was decomposed into benzoic acid, aldol, and aldehyde. Destructive distillation, decomposition at  $100^{\circ}$  with hydrochloric acid, and heating the pure compound at  $150^{\circ}$  in a sealed tube, yielded, in each case, the same products: benzoic acid, crotonic aldehyde, and acetic aldehyde. When warmed with alkali, solution takes place and aldehyde resin is formed. The compound does not react with dilute alkalies, bromine, cold potassium permanganate, or phenylhydrazine. From the behavior of the compound, the author concludes that it is aldehydo-aldolbenzoate,



In the preparation of the substance, sodium acetaldehyde, which is first formed, condenses to a derivative of aldol, which, in turn, reacts with the benzoyl chloride present. As the benzoyl group in the resulting compound is joined to oxygen, the structure of sodium acetaldehyde is  $\text{CH}_3:\text{CHONa}$ . The liquid product of the action of sodium on aldehyde and benzoyl chloride was shown to be aldol benzoate by comparing its behavior, when subjected to destructive distillation, with that of a similar compound prepared from aldol, benzoyl chloride, and sodium.

**On the Constitution of Some Derivatives of Formic Acid.** By PAUL C. FREER AND P. L. SHERMAN, JR. *Am. Chem. J.*, 18, 562-584.—As the physical and chemical properties of formic acid are not in accord with the constitutional formula assigned to it, the authors undertook an investigation of formylphenylhydrazine, formamide, and formic ester, in order to throw some light on the structure of the formyl group —CHO. When formylphenylhydrazine was dissolved in a concentrated alcoholic

solution of sodium ethylate and the solution diluted with ether, a mono-sodium salt crystallized out. To determine the position of the sodium atom, the substance was treated with ethyl iodide under different conditions. When suspended in dry ether, monoethylformylphenylhydrazine was obtained, which melted at 106° and crystallized in rhombohedra. As the compound was not saponified by sodium hydroxide, and its reduction products were aniline and ethylamine, it follows that its structure is  $C_6H_5NH-N(C_2H_5)-CHO$ . It did not react with ethyl iodide and sodium ethylate or with sodium. When the sodium salt of formylphenylhydrazine was dissolved in absolute alcohol, a monoethyl derivative, melting at 78°-79°, and crystallizing in needles, was obtained. Its constitution, as shown by its reduction-products, unsymmetrical ethylphenylhydrazine, ethylaniline, and ammonia, is  $C_6H_5NC_2H_5-NH-CHO$ . When treated with ethyl iodide and sodium ethylate, diethylformylphenylhydrazine was formed. The latter compound did not react with sodium, and gave as reduction-products ethylamine and ethyl aniline. The formation of the two mono-ethyl derivatives excludes the possibility that the sodium atom is attached to oxygen because, were addition of ethyl iodide to take place at the unsaturated nitrogen-linking, with a subsequent splitting off of sodium iodide or hydriodic acid, but one ethyl derivative, with the structure  $C_6H_5NH-NC_2H_5-CHO$ , could be obtained. Acetic anhydride reacted with formylphenylhydrazine, forming a compound in which the acetyl group was joined to nitrogen. Benzoyl chloride and sodium ethylate gave a mono- and dibenzoylformylphenylhydrazine. The sodium derivative of the latter was prepared. Chlorcarbonyl ester and formanilide reacted with the formation of ethylisoformanilide,  $C_6H_5N=CHO.C_2H_5$ , and diphenylformamidine,  $C_6H_5N=CH-NH-C_6H_5$ . Sodium reacted with formic ester in the cold, yielding hydrogen, carbon monoxide, and sodium ethylate. When amyl formate was used, the reaction was slower; sodium amyl formate was first formed and then broke down. The authors conclude that the above reactions prove that the sodium in sodium formylphenylhydrazine is attached to nitrogen and that, therefore, no hydroxyl group is present. They do not furnish any evidence of the presence of an aldehyde group and, consequently, a structural formula according to the present theories is not possible. On the other hand, there is evidence of a hydroxyl grouping in the salts of formanilide. No explanation can be given of the fact that diethylformylphenylhydrazine, in which there is a grouping similar to that in formic ester, does not react with sodium, whereas the ester reacts with sodium readily.

**On Certain Derivatives of Trichlorodinitrobenzol.** By C. LORING JACKSON AND W. R. LAMAR. *Am. Chem. J.*, 18, 664-

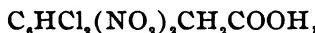
685.—For several years the behavior of tribromdinitrobenzene, melting at  $192^{\circ}$ , with various reagents, has been studied by Jackson and his pupils. The action of the analogous chlorine derivative with aniline, sodium ethylate, and sodium malonic ester is described in the present paper. When heated with aniline, trichlordinitrobenzene, melting at  $129^{\circ}5$ , gives the same trianilidodinitrobenzene which was obtained from tribromdinitrobenzene. With sodium ethylate in the cold, trichlordinitrobenzene lost two of its atoms of chlorine, which were replaced by two ethoxy groups, forming chlordinitroresorcine diethyl ether, which melts at  $160^{\circ}$ . The reaction is analogous to that with the bromine derivative. A hot solution of sodium ethylate changed tribromdinitrobenzene into dinitroresorcine diethyl ether, while, under the same conditions, the chlorine compound was converted into a mixture of dinitrophloroglucine triethyl ether,  $C_6H(NO_2)_2(OC_2H_5)_3$ , which melts at  $104^{\circ}-105^{\circ}$ , and its diethyl ether,  $C_6H(NO_2)_2(OC_2H_5)_2OH$ , melting at  $166^{\circ}$ . When treated with sodium malonic ester, two bromine atoms are removed and bromdinitrophenylmalonic ester,



is formed. Trichlordinitrobenzene gives with the same reagent dichlordinitrophenylmalonic ester,



Both substituted malonic esters are saponified by boiling with sulphuric acid, forming the corresponding phenylacetic acids, but the dichlordinitrophenylacetic acid,



differs from the bromdinitrophenylacetic acid in that the latter is so unstable that five crystallizations from alcohol convert it into bromdinitrotoluene, whereas the former can be crystallized from water without change. When boiled some hours with alcohol, dichlordinitrophenylacetic acid is converted into its ethyl ester. Both substituted malonic esters give red sodium salts, and are converted into nitrites by the action of nitric acid. Bromdinitrophenylacetic acid gives an intense green coloration with sodium hydroxide. Dichlordinitrophenylacetic acid is changed by the same reagent to a red compound, which soon fades to white.

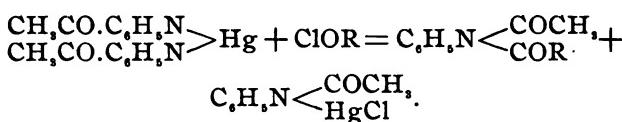
**Camphoric Acid.** By W. A. NOYES. *Am. Chem. J.*, 18, 685-692.—In this paper, the fourth contributed by the author on the subject of camphoric acid, evidence is brought forward which disproves the formula of camphor proposed by Tiemann. In a previous paper (*Am. Chem. J.*, 17, 421), several reasons were given for believing that camphoric acid is a derivative of succinic rather than glutaric acid. This opinion has received

additional support from the work described in the present paper, and it follows, therefore, that Bredt's formula for camphor is also incorrect. As it has been shown by the author (*loc. cit.*) that dihydrohydroxycampholytic acid contains a tertiary hydroxyl group, it follows that the carboxyl of aminolauronic acid is also tertiary. Independent investigations of Walker (*J. Chem. Soc.*, 63, 506) and the author (*Am. Chem. J.*, 16, 509; and *loc. cit.*) prove that the carboxyl in dihydroaminocampholytic acid is secondary. There should, accordingly, be a marked difference in the rate of esterification of the two acids. Ten times as much ester was obtained from the latter as from the former. The result disproves Tiemann's formula, for according to it the rate of esterification should be identical in both cases. The ethyl ester of aminolauronic acid is a mobile, strongly basic liquid with an ammoniacal, aromatic odor, and forms a sulphate difficultly soluble in water, which crystallizes in pearly-white plates. When the sulphate of the ester of aminolauronic acid is treated with a strong solution of sodium nitrite, it is decomposed with the formation of the ethyl ester of  $\gamma$ -lauronic acid and a small amount of the ester of a new hydroxylauronic acid. The two acids are separated by distillation with steam, after saponification of the esters. The hydroxy acid, which is non-volatile, is extracted with ether and is left, after evaporation of the solvent, as a viscous, hygroscopic liquid, which forms an insoluble copper salt,  $(C_6H_{14} < \begin{matrix} CO \\ OH \end{matrix})_2Cu + H_2O$ . The acid was shown to have a secondary hydroxyl group by the action of Beckmann's chromic acid mixture, which transformed it into the  $\beta$ -ketonic acid, which immediately decomposed into a ketone and carbon dioxide. Dihydro-cis-campholytic acid was prepared by reducing cis-campholytic acid with amyl alcohol and sodium. It melts at  $244^\circ$ , has the specific gravity 0.9833 at  $20^\circ$ , and is stable toward a cold solution of potassium permanganate. The amide melts at  $161^\circ$ .  $\alpha$ -bromdihydro-cis-campholytic acid was prepared by treating the acid with phosphorus pentachloride and bromine. It melts at  $129^\circ$ – $130^\circ$ , and when treated with cold alcoholic potash, hydrobromic acid is removed and cis-campholytic acid is regenerated. This furnishes a new proof that the double union of cis-campholytic acid is in the  $\alpha$ - $\beta$  position and gives additional support to the view that the two campholytic acids are stereoisomers. Attempts to reduce the cis-trans-campholytic acid were unsuccessful. According to Armstrong's formula for camphor, cis-campholytic acid must be  $\Delta^1$ -tetrahydroxylic acid. The reduction of xylylic acid,  $C_6H_5(CH_3)_2(1, 3)COOH(4)$ , would give four stereoisomers, corresponding to which there would be four  $\alpha$ -bromhexahydroxylic acids. Two of these, supposing Armstrong's formula to be correct, would give ciscampholytic acid when treated with alcoholic

potash ; and two would give either cis-trans-campholytic acid or  $\Delta^1$ -tetrahydroxylylic acid. From the hexahydro acid, obtained by the reduction of xylylic acid, the  $\alpha$ -brom derivative was prepared and, on treatment with alcoholic potash, did not yield any of the above products. The formula of Armstrong cannot, therefore, be the correct one.

**Derivatives of Dihydro-cis-campholytic Acid.** By E. B. HARRIS. *Am. Chem. J.*, 18, 692-695.—From the amide of dihydro-cis-campholytic acid prepared by Noyes (see preceding abstract), an amine,  $C_8H_{11}NH_2$ , was prepared by the action of potassium hypobromite. It is slightly soluble in water, boils at  $156^{\circ}.5$ , and has the specific gravity 0.8431 at  $20^{\circ}$ . The chloride, sulphate, and chlorplatinate are described. In order to obtain the alcohol corresponding to the amine, the latter was converted into the sulphate and treated with sodium nitrite. The greenish-yellow oil obtained was separated by distillation with steam into an oil which boiled at  $122^{\circ}$ , probably the hydrocarbon  $C_8H_{14}$ ; a small quantity of a white crystalline substance, which was not identified; and an oil which contained the alcohol  $C_8H_{15}OH$ . The latter was treated with Beckmann's mixture of sulphuric acid and potassium bichromate and the resulting ketone, after purification, converted into the oxime, which melted at  $112^{\circ}-113^{\circ}$ . The properties of the oxime agree closely with those of the one prepared by Kipping (*J. Chem. Soc.*, 67, 357) from dimethyl-(1, 3)-cyclohexenone-(2). If the oximes are identical, campholytic acid is  $\Delta^1$ -tetrahydro-(1, 2, 3)-xylylic acid.

**On Diacid Anilides.** By H. L. WHEELER. *Am. Chem. J.*, 18, 695-703.—In recent papers (*Am. Chem. J.*, 18, 381; 18, 540) the author has shown that by the action of benzoyl chloride on the silver and mercury salts of the anilides, mixed diacid anilides can be obtained. In the present paper it is shown that the action of aliphatic chlorides is analogous to that of benzoyl chloride, and that the resulting diacid anilides react with alkali with the separation of the lower acid radical and the formation of the anilide of the higher acid. From this reaction it appears that the diacid anilides are nitrogen derivatives. The method of preparation was as follows : Silver formanilide or mercury acetamide was suspended in dry ether or benzene and one molecular proportion of acid chloride added. The action began immediately and was complete, in the case of the lower acid chlorides, in a few minutes. After filtering from the silver chloride or the halogen mercuric compound, the filtrates were shaken with water, and on evaporation of the solvent the diacid anilides were obtained as oils, which were purified by fractionation under diminished pressure. The reaction is as follows :



The following compounds were prepared : Acetylacetanilide, formylacetanilide, formylpropionanilide, formyl-*n*-butyranilide, formylstearanilide, acetylpropionanilide, acetyl-*n*-butyranilide, acetylisovaleranilide, and acetylpalmitanilide. Formylpropionanilide and formylstearanilide are easily decomposed by heat, the former giving propionanilide, and the latter phenylisocyanide and stearic acid. Diacid amides are not formed by the action of acid chlorides on benzamide, the chief product being benzonitrile. From this fact it follows that different structures must be assigned to amides and anilides, if the action of acid chlorides is a direct double decomposition in both cases. The author suggests the possibility of the formation of unstable addition-products in one case, which break down into simple bodies.

**On Malonic Nitrile and Some of its Derivatives.** By B. C. HESSE. *Am. Chem. J.*, 18, 723-751.—In order to determine whether the metal is joined to nitrogen or to carbon in the salts of malonic nitrile, the silver and sodium derivatives were prepared and their reactions with a number of reagents studied. Dry cyanacetamide, suspended in ether, does not react with sodium unless alcohol is present, when the mono-sodium salt is obtained. Dibromcyanacetamide is found by the action of one molecular proportion of bromine on cyanacetamide in aqueous solution. Malonic nitrile was prepared by fractionating the product obtained by heating equal weights of phosphorus pentachloride and cyanacetamide at 90° until the evolution of hydrochloric acid ceased. It is a white, ice-like solid, which melts at 29° and boils at 219°-220°. By the action of bromine on malonic nitrile, fused or in aqueous solution, a mixture of oils and amorphous and crystalline solids is produced. The latter bodies alone were studied, and proved to be the brom- and dibromderivatives of the nitrile. Brommalonic nitrile melts at 65°-66° and does not form a nitro compound with silver nitrite. Dibrommalonic nitrile melts at 123°.5-124°. The silver salt, formed by precipitating a cold aqueous solution of malonic nitrile (one molecule) with a cold solution of ammoniacal silver nitrate (two molecules), is a mixture of the mono- and disilver derivatives. This mixture gives with ethyl iodide, besides amorphous substances, diethyl malonic nitrile and ethyl isocyanide. The formation of the latter bodies is best explained if the structure assigned to the silver salt is  $\text{AgN} : \text{C} : \text{C} : \text{C} : \text{N}\text{Ag}$ . The addition of alkyl iodide to the double bonds between the carbon atoms and subsequent elimination of silver iodide would give dialkyl malonic nitrile. The formation of an isocyanide is explained

by the direct replacement of the silver by alkyl. The fact that no isocyanide is formed when the sodium salt of malonic nitrile is used is in accord with the above structure, as it is well known that sodium salts do not act by direct replacement as readily as silver salts. A mixture, probably of sodium malonic nitrile and sodium ethylate, was obtained in an attempt to prepare a disodium derivative of the nitrile. With methyl and ethyl iodides this mixture gave, when heated in sealed tubes for eight hours at 100°, dimethyl and diethyl malonic nitrile, melting at 32° and 44°, respectively. By the action of sodium ethylate on a mixture of malonic nitrile and ethyl chlorformate, sodium di-cyanacetic acid ethyl ester was prepared. Malonic nitrile, sodium methylate, and methyl iodide gave a mixture of dimethyl malonic nitrile and dimethyl cyanacetimidomethyl ether,

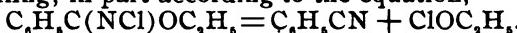
$\text{CN} > \text{C} - \text{C} \begin{cases} \text{NH} \\ // \\ \backslash \end{cases} \text{OCH}_3$ . The presence of the latter compound was proved by dissolving the mixture in water and precipitating methyl dimethylcyanacetate,  $\text{CH}_3 > \text{C}(\text{COOCH}_3)_2$ , with hydrochloric acid. Analogous ethyl compounds were prepared. Diethylcyanacetamide,  $\text{C}_2\text{H}_5 > \text{C}(\text{CONH}_2)_2$ , was formed in the preparation of diethylmalonic nitrile, and when the latter compound was boiled with absolute alcohol containing 1.3 per cent. of sodium. Diethylcyanacetic acid was prepared from the amide and, when heated in concentrated hydrochloric acid in a sealed tube at 160° for eight hours, was transformed into diethylacetic acid.

**On the "Bechmann Rearrangement."** BY JULIUS STIEGLITZ. *Am. Chem. J.*, 18, 751-762.—The author offers the following explanation of the transformation of acid bromamides into isocyanates in the presence of an alkali. The alkali causes a direct loss of hydrobromic acid, producing the body  $\text{RCO.N} <$  with a univalent nitrogen atom, whose reactivity is great enough to take away the alkyl group from the carbon atom. The fact that acid dibromamides,  $\text{RCO.NBr}_2$ , chloranilides, and analogous bodies,  $\text{RCO.NCl}_2$ , do not suffer a similar rearrangement with alkali is in accord with this view. A number of the reactions of

the acid azides  $\text{RCO.N} < \begin{matrix} \text{N} \\ || \\ \text{N} \end{matrix}$ , can be explained in the same way.

Two atoms of nitrogen are liberated, leaving the group  $\text{RCO.N} <$ , which suffers a molecular rearrangement, forming an isocyanate. In the presence of reducing agents in alkaline solution, two groups might unite forming diacyl,  $\text{RCO.N} = \text{N.COR}$ , which, by taking up two hydrogen atoms, would give the diacylhydrazine  $\text{RCONH.NHCOR}$  actually obtained. When reduced in

acid solution, two atoms of hydrogen are added to the unsaturated group,  $\text{RCO.N} <$ , forming an acid amide. As it has not been determined whether the salts of the acid bromamides, which are formed before the transformation to the isocyanate takes place, have the structure  $\text{RC}(\text{NBr})\text{OMe}$  or  $\text{RCO}(\text{NBrMe})$ , the author has investigated a number of compounds with analogous composition having alkyl groups in place of the metallic atoms. No rearrangement has been observed. Chlorimidoethylbenzoate,  $\text{C}_6\text{H}_5\text{C}(\text{NCI})\text{OC}_2\text{H}_5$ , prepared by the action of sodium hypochlorite and hypochlorous acid on benzimidooethyletherhydrochloride, is a colorless oil, insoluble in water, which boils at  $131^\circ$ - $132^\circ$  at 16 mm. pressure. An alcoholic solution evolves chlorine with hydrochloric acid and nitrogen with ammonia. When chlorimidoethyl benzoate was heated, decomposition took place, with violent boiling, in part according to the equation,



Benzamide and a trace of an aniline derivative were secondary products of the reaction. Bromimidoethyl benzoate was much less stable than the chlorine compound.

**Menthene Nitrosochloride and Some of Its Derivatives.** By W. O. RICHTMANN AND EDWARD KREMERS. *Am. Chem. J.*, 18, 762-780.—Menthene, prepared by heating menthol with anhydrous copper sulphate for ten hours, after six fractionations, boiled from  $165^\circ$  to  $169^\circ$ . A 15 per cent. yield of the fraction boiling at  $167^\circ$ - $167^\circ.5$  was obtained and had the specific gravity 0.8103 and the rotary power  $[\alpha]_D = +29^\circ.63$ . Menthene nitrosochloride was prepared from the different fractions of the menthene and purified by fractional crystallization. Products were obtained which melted from  $106^\circ$  to  $117^\circ$  and whose rotary power varied from  $-2^\circ.408$  to  $+16^\circ.715$ . The menthene nitrobenzylamine prepared from the different specimens of the nitrosochloride melted at  $105^\circ.5$ - $106^\circ.5$ , and was inactive. The purest sample of nitrosomenthene obtained, melted at  $64^\circ$ - $65^\circ$  and had the rotary power  $-4^\circ.683$ . The ketone prepared from the nitrosomenthene boiled from  $205^\circ$  to  $218^\circ$ . The fraction boiling at  $207^\circ$ - $208^\circ$  was obtained to the extent of 40 per cent. and had the specific gravity 0.9163 and the rotary power  $-1^\circ.3189$ . A sample of inactive nitrosomenthane gave a ketone which had the rotary power  $+0^\circ.4299$ . By the action of hydrogen sulphide on an alcoholic solution of the ketone, a hydrosulphide,  $\text{C}_{10}\text{H}_{16}\text{O}_2\text{H}_2\text{S}$ , was formed. With phenylhydrazine, a very unstable hydrazone, which melts at  $72^\circ.5$ - $73^\circ$ , was obtained. The product obtained by reducing the ketone consisted mainly of unchanged ketone. By the dehydration of the alcohol  $\text{C}_{10}\text{H}_{18}\text{O}$ , a hydrocarbon was not obtained, but a compound which formed an oxime and a hydrosulphide.

**On the Non-Existence of Two Orthophthalic Acids.** By H.

L. WHEELER. *Am. Chem. J.*, 18, 829-836.—W. T. Howe (*Am. Chem. J.*, 18, 390) recently published an account of a new orthophthalic acid and a number of its derivatives. The author has endeavored, in a series of eight experiments, to obtain the new acid by following the directions given. In every case ordinary phthalic acid was obtained. The author further shows that the analyses of the aniline salts of the two acids, although they agree with one another and the calculated figures as given, do not agree with the true values. The analyses of the brucine salts do not agree with either the calculated values given or the true ones.

**The Action of Sulphuric Acid on Anisol.** By W. B. SHOBER. *Am. Chem. J.*, 18, 858-865.—Anisol was treated with sulphuric acid, the amount of acid, the temperature at which the mixture was heated, and the time of heating, varying with each experiment. In order to separate the resulting acids, they were transformed into amides. Anisoldisulphonic acid was formed in every case when the mixture was heated on the water-bath to 92°, the proportion of the acid increasing with the increase in the proportion of the sulphuric acid, and with the increase in the time of heating. It is not formed at a temperature of 125°. When 10 grams of anisol and 80 grams of sulphuric acid were heated at 91° for 30 minutes, 97.6 per cent. of the resulting amides was anisoldisulphonamide. Parานisolumonosulphonic acid was formed in every experiment, the amount decreasing with increase of temperature, time of heating, and excess of sulphuric acid. 80 grams of sulphuric acid and 40 grams of anisol, heated at 92° for 35 minutes, gave a mixture containing 91.6 per cent. paramide. Orthoanisolumonosulphuric acid was formed in greatest quantity when anisol and sulphuric acid reacted at ordinary temperatures. 54.6 grams of sulphuric acid and 28.1 grams of anisol yielded a mixture containing 12.5 per cent. of the orthoamide.

**Dipyridine Methylene Iodide and the Non-Formation of the Corresponding Monopyridine Products.** By S. H. BAER AND A. B. PRESCOTT. *J. Am. Chem. Soc.*, 18, 988-989.—Dipyridine methylene iodide,  $C_6H_5N\begin{array}{c} CH_2 \\ | \\ I \end{array}>NC_6H_5$ , was prepared by boiling for one hour molecular proportions of pyridine and methylene iodide, diluted with an equal volume of alcohol. The compound crystallizes in yellow needles, which decompose at 220°, and is soluble in water and in hot alcohol, and insoluble in ether, chloroform, and benzene. Dipyridine methylene bromide was obtained by digesting pyridine and methylene bromide in a sealed tube for two weeks. It melts at 295° and crystallizes in colorless plates. It was impossible to make mono-pyridine products.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

# REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

## GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

**Determination of Atomic Masses of Silver, Mercury and Cadmium by the Electrolytic Method.** By WILLETT LEPLEY HARDIN. *J. Am. Chem. Soc.*, 18, 990-1026.—All the successful determinations described in this article were made by electrolyzing in a platinum dish potassium cyanide solutions of weighed quantities of various salts of the three metals, and by weighing the amount of metal deposited. Separate series, each consisting of ten experiments, were made in this way with silver nitrate, acetate, and benzoate; mercuric chloride, bromide, and cyanide; cadmium chloride and bromide. The final values of the atomic weights so obtained are 107.928 for silver, 199.99 for mercury, and 112.05 for cadmium, in close agreement with the values derived by Clarke from the work of previous investigators (107.92, 200.0 and 111.93.)

**The Atomic Weight of Nitrogen and Arsenic.** By JOSEPH GILLINGHAM HIBBS. *J. Am. Chem. Soc.*, 18, 1044-1050.—The author has determined the atomic weights of nitrogen and arsenic by passing hydrochloric acid gas over weighed quantities of potassium and sodium nitrates and over sodium pyroarsenate, and weighing the residual sodium chloride. The values obtained are 14.0117 and 74.916 respectively. Those selected as most probable by Clarke in his last year's report are 14.04 and 75.09.

**Chemistry and Its Laws.** By F. WALD. *J. Phys. Chem.*, 1, 21-33. As this article is by a foreign author, and as the substance of it has already appeared in a more extended form in a foreign journal (*Ztschr. phys. Chem.*, 18, 357), a reference to its title will answer the purposes of this review.

**On Ternary Mixtures.** By WILDER D. BANCROFT. *J. Phys. Chem.*, I, 34-50.—This article is a continuation of a previous one on the same subject (see *Tech. Quart.*, 8, 306). The author shows that the solubility of salts in mixtures of water and alcohol can be expressed by the equation:  $(x + A)y^n = C$ , in which  $x$  represents the quantity of alcohol, and  $y$  the quantity of the salt, in a definite quantity of water, and in which  $A$ ,  $n$  and  $C$  are constants determined from the experiments themselves. He shows further that the solubility  $x$  of a salt in an aqueous solution containing the quantity  $y$  of another salt can be expressed by the equation:  $(x + A)(y + B)^n = C$ , an equation which contains *four empirical constants*. The reviewer has already pointed out (*Tech. Quart.*, 8, 306), that no physical significance whatever can be attached to such results, a fact which will be evident to any one acquainted with the properties of empirical equations; for, if the introduction of so many arbitrary constants be permitted, a great variety of mathematical functions could be found which would represent the experimental results with a practically equal degree of accuracy. The agreement is, in other words, almost a mathematical necessity, and is therefore no evidence of the correctness of the author's application of the mass-action law to the phenomenon in question.

**Precipitation of Salts.** By H. A. BATHRICK. *J. Phys. Chem.*, I, 157-169.—The author has determined the solubility of potassium, sodium and ammonium chlorides, and of potassium and sodium nitrates, in various mixtures of water and alcohol, and of the last two salts in mixtures of water and acetone. He shows that his own results and also those of Nicol on the solubility of salts in the presence of one another can be expressed by the formulas proposed by Bancroft. He also discusses the criticism of the reviewer (see preceding review), in regard to the use of so many arbitrary constants, and points out that one of them,  $A$ , has the same value for a definite salt, whatever be the other substance by which it is precipitated. But strangely enough, according to the author's own calculations, this statement is not correct. And, if it were, it is not to be doubted that the three remaining arbitrary constants would suffice to make almost any form of function express the results satisfactorily.

**Solution and Fusion.** By WILDER D. BANCROFT. *J. Phys. Chem.*, I, 137-148.—This article contains no new experimental data, but presents the opinions of the author on certain subjects related to those named in the title.

**Nascent Hydrogen.** By R. FRANCHOT. *J. Phys. Chem.*, I, 75-80.—The author finds that a neutral ferric sulphate solution is reduced by metallic zinc, cadmium and copper, and concludes

that in acid solutions this direct reduction takes place simultaneously with that caused by the nascent hydrogen.

**Speed of Esterification, as Compared with Theory.** By ROBERT B. WARDER. *J. Phys. Chem.*, I, 149-156.—The author shows that the rate of esterification of alcohol and the three chloracetic acids, as determined by Lichty (*Tech. Quart.*, 8, 99), does not conform to the requirements of the laws of mass-action in the form applicable to a reversible reaction of the second order, and he suggests four possible causes of the deviations.

H. M. GOODWIN, REVIEWER.

**The Specific Heat of Metals.** By F. A. WATERMAN. *Phys. Rev.*, 4, 161-191.—The author has perfected Heselius' method of determining specific heats, and shows by numerous examples that it is capable of a high degree of accuracy. In this method the calorimeter is placed in the bulb of an air thermometer with an attached manometer, and the rise of temperature, due to the introduction of the hot substance, is exactly compensated by the addition of ice-water drop by drop until the manometer registers the original pressure within the air thermometer. An electric heater is provided for heating the substance to any initial temperature. This swings over the calorimeter for the introduction of the hot substance through a trap in the bottom of the heater. Without moving the calorimeter, the ice-water reservoir may be swung around in place of the heater, for the final operation. The apparatus described seems a model of convenience. The metals used were of a high degree of purity. The following results (the mean of a number differing by less than 0.1 per cent.) of the mean specific heat between 100° and 20° were obtained: Bismuth, 0.03035; tin, 0.05453; aluminum, 0.021946; copper, 0.09471; gold, 0.03068; zinc, 0.09547. The article contains in addition a compilation of the literature, and the results of all the more reliable specific heat determinations by different investigators; also a table of the most probable values of the mean specific heat of the metals, the determinations by different methods and observers being carefully weighted and combined. From a chemical standpoint the article is of especial interest as a presentation of the most accurately determined atomic heat values, illustrating the degree of validity of the Principle of Dulong and Petit. The author adopts 6.24+ as the most probable average value of the atomic heat.

**On the Viscosity of Mercury Vapor.** By A. A. NOYES AND H. M. GOODWIN. *Phys. Rev.*, 4, 207-217.—The authors have determined the relative weights of mercury vapor, carbon dioxide and hydrogen, which were transpired under like conditions

of temperature, (that of boiling mercury,  $357^{\circ}$ ) and of pressure difference through the same capillaries in equal times, from which the relative viscosity and relative cross-section of the molecules of these gases could be computed. Experiments made at different pressures conformed to O. E. Meyer's pressure formula completely. For the more reliable capillary (74 cm. long and 0.34 mm. internal diameter), the values found for the relative viscosity  $\eta$  were:  $\eta_{\text{Hg}} : \eta_{\text{CO}_2} = 2.08$ ;  $\eta_{\text{Hg}} : \eta_{\text{H}_2} = 4.04$ ;  $\eta_{\text{CO}_2} : \eta_{\text{H}_2} = 1.94$ . The corresponding values of the relative mean cross-sections  $q$  were:  $q_{\text{Hg}} : q_{\text{CO}_2} = 1.02$ ;  $q_{\text{Hg}} : q_{\text{H}_2} = 2.48$ ; that is, the mean cross-section of the monatomic mercury molecule is nearly the same as the tri-atomic carbon dioxide molecule, and 2.5 times greater than that of the hydrogen molecule. These results indicate that atoms and molecules are of the same order of magnitude, and therefore that the interatomic spaces within molecules are not large in comparison with the size of the atoms. Properties like viscosity which depend on the size or form of molecules are therefore not well adapted for distinguishing between monatomic and polyatomic molecules.

**On the Specific Gravity and Electrical Conductivity of the Normal Solutions of Sodium and Potassium Hydroxides and Hydrochloric, Sulphuric, Nitric and Oxalic Acids.** By E. H. LOOMIS. *Phys. Rev.*, 4, 252-255.—The following results were obtained by the usual pyknometer and conductivity methods for normal solutions, which had been prepared with special care as to the purity of the substances used :

Compound.	Sp. gr. $\frac{18^{\circ}}{4^{\circ}}$ .	K. $10^7$ .
NaOH	1.0418	148
KOH	1.0481	170
HCl	1.0165	279
HNO <sub>3</sub>	1.0324	278
H <sub>2</sub> SO <sub>4</sub>	1.0306	183
(COOH),	1.0199	55

**Note on the Theory of the Voltaic Cell.** By H. M. GOODWIN. *Phys. Rev.*, 4, 241-246.—This is a reply to certain criticisms of Mr. Bancroft of an article by the author on the theory of the voltaic cell and its application to the calculation of the solubility of depolarizers of electrodes of the second kind. The author shows by experiments that the electromotive force of elements of the form  $\text{Zn}, 0.1n\text{ZnCl}_4, 0.1n\text{ZnBr}_2, \text{Zn}$  is practically zero exactly as is required by Nernst's theory, according to which the potential difference between a metal and an electrolyte is primarily determined by the *kation* concentration of the solution and not by that of the anions. Mr. Bancroft predicted

for cells of this type very considerable electromotive forces, because according to his views, the potential difference between a metal and electrolyte is primarily determined by the *anions*. Moreover, experiments on similar reversible cadmium cells demonstrate with what certainty one may predict results from the osmotic theory, when the kation concentration of the metals used as electrodes is known. Experiments made with the abnormally dissociated halogen salts of cadmium and its nitrate, completely confirmed the conclusion derived by other methods that the nitrate, chloride, bromide and iodide are very unequally dissociated with respect to the cadmium ion, the nitrate being the most, and the iodide the least dissociated.

**On Irreversible Cells.** By A. E. TAYLOR. *J. Phys. Chem.*, 1, 1-21, 81-91.—This investigation is a continuation of that of Bancroft on the chemical potential of the metals. The author finds in the good agreement of independent measurements of the electromotive force of non-reversible cells, reason for accepting Bancroft's view that such cells are limiting cases of reversible cells and possess a definite electromotive force. Further experiments, however, force him to reverse the Bancroft radical opinions regarding the influence of the anion. The main conclusions of his paper are namely: first, that the potential difference between a metal and an electrolyte is *not* a function of the negative ion of the salt solution; and second, that in certain cases dropping mercury electrodes do not give correct values for the single potential differences measured by that method.

**Purification of Water by Distillation.** By G. A. HULETT. *J. Phys. Chem.*, 1, 91-95.—The still used was an ordinary retort of two liters capacity with a platinum condenser so arranged that only the vapor condensed within this tube was collected. Water distilled with potassium permanganate gave after one-fourth had been rejected, a distillate of nearly constant conductivity of the value:  $K \times 10^{10} = 0.77$ . Ordinary distilled water first distilled from an acid solution of potassium bichromate, and afterwards from barium hydrate gave equally good if not better results:  $K \times 10^{10} = 0.76-0.71$ . It is also found that the quality of the water was independent of the *rate* of distillation when barium hydrate was employed. Free sulphuric acid should not be used as it passes over into the distillate.

**Viscosity of Mixtures of Liquids.** By C. E. LINEBARGER. *Am. J. Sci.*, 152, 331-341.—Continuing his researches on the properties of mixtures of "Normal" liquids, the author has in this paper extended his experiments to their viscosity. Ostwald's well known form of apparatus was used and all measurements were made at  $25^\circ$ . Sixteen different mixtures were investigated, and

in no case was a maximum of viscosity observed; the origin of the maximum observed by other investigators is to be sought in their use of associated liquids. In most mixtures investigated, the observed viscosities are less than those calculated by the rule of mixtures. In certain mixtures, however, as those of benzene, with toluene, carbon disulphide and chloroform the differences are less than the experimental errors.

**The Spectra of Argon.** By JOHN TROWBRIDGE AND THEODORE WILLIAM RICHARDS. *Am. J. Sci.*, 153, 15-20.—With the unusual facilities for investigating vacuum tube spectra afforded by a Planté battery of 5000 cells, the authors have made some very interesting experiments on the conditions necessary for the production of the "red" and "blue" spectra of argon, with a sample furnished by Lord Rayleigh. It was found that with a tube of large capillary and 15 cm. in length containing argon under a pressure of one millimeter, 2000 volts were sufficient to produce the red glow, a very much lower potential than that (27,600 volts) estimated by Crookes. The introduction of a condenser and spark gap between the terminal of the Geissler tube caused the red glow to disappear, and the peculiar blue glow to take its place. The potential necessary was estimated at not over 2000 volts. By a number of other experiments it was shown that the blue glow is produced by an oscillatory discharge, while the red glow is the result of an unidirectional discharge. So sensitive is argon to electrical oscillations in this respect that the authors propose to call an argon tube fitted for the study of electrical waves, for which it seems peculiarly adapted, a talantoscope.

**On the Hydrolysis of Ferric Chloride.** By H. M. GOODWIN. *Tech. Quart.*, 9, 254-271. The gradual change which a neutral ferric chloride solution undergoes when a concentrated solution is suddenly diluted, which is indicated by a gradual change in its color from a light yellow to a deep reddish brown, was investigated by measuring the simultaneous increase in the electrical conductivity (at 25° F. of solutions varying from 0.1 to 0.0001 molecular normal). The measurements showed: *First*, that the molecular conductivity of dilute solutions increases with the time. *Second*, that the rate of increase increases very rapidly with the dilution. *Third*, that the increase in the conductivity does not begin at once on dilution, but only after the lapse of a certain time. *Fourth*, that the time elapsing before the reaction apparently begins, increases very rapidly with the concentration; thus the reaction as indicated by change of color and increase of conductivity begins after about one minute for a 0.0006 normal solution, 15 minutes for a 0.0012 normal solution, 4 days for a 0.015 normal solution. *Fifth*, that the

time required for the completion of the reaction increases enormously with the concentration; for example, it is 3 hours for a 0.0001 normal solution, but over a week for a six times stronger solution. And *sixth*, that the reaction when once started progresses slowly at first, then more and more rapidly up to a maximum, after which the velocity decreases, until a condition of equilibrium is finally reached. The explanation suggested to account for this remarkable behavior is that, on first diluting a ferric chloride solution, the hydrolytic reaction

$$\text{Fe}^{+++} + \text{H}_2\text{O} \rightleftharpoons \text{FeOH}^+ + \text{H}^+$$

instantly takes place, whereby the conductivity is increased by an amount proportional to the difference of the migration velocities of the hydrogen and ferric ions. This is in agreement with the fact that the initial conductivity increases more rapidly than can be accounted for by electrolytic dissociation alone. The subsequent progressive change of color and of the conductivity of the solution is due to the gradual formation of undissociated deeply colored colloidal hydrate, according to the reaction  $x\text{FeOH}^+ + x_2\text{OH}^- = (\text{FeO}, \text{H}_2)_x$ . A calculation under this assumption of the true initial *hydrolytic* dissociation from a combination of conductivity and freezing-point determinations makes it probable that the hydrolytic dissociation increases very rapidly with the dilution, being about 2 per cent. for a 0.1 to 0.2 normal solution, and 90 per cent. for a 0.0015 normal solution.

**The Freezing-Points of Dilute Aqueous Solutions, III.** By E. H. LOOMIS. *Phys. Rev.*, 4, 273-297.—In this paper the author has extended his well known work on freezing-points to solutions of the following compounds: LiCl, CaCl<sub>2</sub>, SeCl<sub>2</sub>, SnCl<sub>4</sub>, HNO<sub>3</sub>, KOH, NaOH, KH<sub>2</sub>PO<sub>4</sub>, Na<sub>2</sub>HPO<sub>4</sub>, Na(NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>, Na<sub>2</sub>PO<sub>4</sub>, Na<sub>2</sub>SiO<sub>3</sub>, and acetic, oxalic, succinic, tartaric, and citric acids. By working in a room at about 3°C., the temperature variations of which did not exceed 0.5°C., the experimental error previously estimated at 0.001°C. has been reduced one-half. Among the important relations brought to light by a consideration of the results may be mentioned the following: The molecular depression of the freezing-point of all chlorides reaches a minimum value which is especially pronounced in the case of the chlorides of the alkali earths. Stannic chloride exhibits an abnormally large molecular lowering, 12.61 for  $m = 0.01$ , which is probably to be explained by its being highly hydrolyzed in dilute solution. A study of the phosphates indicates that salts of the type KH<sub>2</sub>PO<sub>4</sub> are dissociated into two ions, K and H<sub>2</sub>PO<sub>4</sub><sup>-</sup>; salts of the type K<sub>2</sub>HPO<sub>4</sub> into three ions, K, K, and HPO<sub>4</sub><sup>2-</sup>; while the neutral phosphate K<sub>2</sub>PO<sub>4</sub> is dissociated into four ions. Phosphoric acid itself is, as has been long known, but little dissoci-

ated, only one hydrogen ion being probably split off from the molecule. Sodium silicate also gave abnormal lowerings, the higher values observed being undoubtedly due to an hydrolysis of the salt. Acetic, tartaric and succinic acids, and also the chlorides of lithium and calcium gave results in complete agreement with those of electrical conductivity measurements. Nitric acid, and potassium and sodium hydroxide, on the other hand, gave results for the dissociation deviating as much as 8 to 11 per cent. from conductivity values. The reason for this discrepancy is not known. It seems to the reviewer that much weight should be given to the results of this investigator, in view of the clearness with which he has discussed the precision side of this problem and his thorough appreciation of the nature and magnitude of the errors affecting his measurements.

**On the Formation of Lead Sulphate in Alternating Current Electrolysis with Lead Electrodes.** By SAMUEL SHELDON AND MARCUS B. WATERMAN. *Phys. Rev.*, 4, 324-327.—The formation of lead sulphate by the passage of an alternating current through a sulphuric acid solution between lead electrodes was found to diminish with rise of temperature, to increase very rapidly with the number of alternations up to twenty per second, after which it decreases, and to increase rapidly to a constant value with increasing current density.

**Polarization and Internal Resistance of a Galvanic Cell.** By B. E. MOORE AND H. V. CARPENTER. *Phys. Rev.*, 4, 329-336.—The authors have studied the polarization at each electrode of a Leclanche cell, by combining each successively with a third non-polarized carbon electrode kept on open circuit. Both electrodes were found to be polarized, the larger part of the total polarization of the cell being at the carbon electrode however. That zinc in ammonium chloride would by the passage of any considerable current become polarized might have been predicted from Nernst's theory of the cell, since it is a non-reversible electrode with respect to the cation. The rapid recovery of the electromotive force of the cell on open circuit was found to be largely due to recovery from polarization at the zinc electrode, the recovery at the carbon electrode being much slower.

**ANALYTICAL CHEMISTRY.****ULTIMATE ANALYSIS.**

H. P. TALBOT, REVIEWER.

**Table of Factors.** By EDMUND H. MILLER AND J. A. MATHEWS. *J. Am. Chem. Soc.*, 18, 903-904.—The table presents about fifty factors, commonly required for analytical work. They are calculated from the atomic weights published in Clarke's table (*J. Am. Chem. Soc.*, 18, 213). The use of seven-place logarithms, and six decimal places in the values of the factors is somewhat misleading and involves unnecessary labor. Five-place logarithms suffice for the highest accuracy in chemical analysis, and even four-place logarithms and four places of decimals in the factors are sufficiently accurate, except in a few extreme cases.

**Some Analytical Methods Involving the Use of Hydrogen Dioxide.** By B. B. ROSS. *J. Am. Chem. Soc.*, 18, 918-923.—The author proposed to determine iron by a procedure in which an excess of potassium bichromate is added, which is allowed to react with hydrogen peroxide, and, from the volume of oxygen liberated, the excess of bichromate is estimated. A similar procedure is proposed for the determination of sugar, wherein cuprous oxide is to be oxidized by potassium bichromate, and the excess of the latter estimated from the oxygen evolved on contact with hydrogen peroxide. The article leaves the reader in doubt whether or not the processes proposed have any real value.

**The Separation of Thorium from the Other Rare Earths by Means of Potassium Trinitride.** By L. M. DENNIS. *J. Am. Chem. Soc.*, 18, 947-952.—The author shows that thorium is quantitatively precipitated as hydroxide by potassium trinitride, and that its separation from cerium, lanthanum, and didymium may be promptly and completely effected by means of this reagent.

**Notes on Reinsch's Test for Arsenic and Antimony.** By JAS. LEWIS HOWE AND PAUL S. MERTINS.—*J. Am. Chem. Soc.*, 18, 953-955.—The authors find that a confusion of antimony with arsenic in this test is not likely to occur, since on heating the copper upon which the deposition has taken place, the arsenic forms well defined octrahedral crystals of the oxide, while the antimonious oxide shows no trace of crystallization. The deposition in the case of the arseniates is slow, and it fails altogether in the presence of nitric acid or chlorates. Organic matter does not interfere with the test. The antimony deposits more slowly than arsenic on the copper and shows a violet tint.

**Notes on the Determination of Phosphorus in Steel and Cast Iron.** By GEORGE AUCHY. *J. Am. Chem. Soc.*, 18, 955-970.—From the experiments cited, the author concludes that in order to insure a complete reduction of the molybdic acid to  $\text{Mo}_3\text{O}_9$ , dilution must be absolutely avoided after the solution has passed the reductor; that it is not necessary to wash out the reductor with acid, except after long standing; that when the zinc for reduction is placed in the liquid and the excess removed by filtration, the molybdic acid is reduced only to  $\text{Mo}_{10}\text{O}_{29}$ ; that dilute solutions of this oxide are less stable than concentrated solutions; that a boiling temperature must be avoided during reduction and solution of the zinc, and that air must be excluded while cooling the solution before filtration; that cotton wool is preferable to paper as a filtering medium; that a considerable excess of sulphuric acid increases the stability of the reduced solution; and that the reduction by means of zinc within the solution, the excess of which is removed by filtration through cotton, is the most desirable method for phosphorus determinations. He also finds that sugar may be used to reduce and dissolve the manganese dioxide from the permanganate added to oxidize the phosphorus.

**Metal Separations by Means of Hydrochloric Acid Gas.** By J. BIRD MOYER. *J. Am. Chem. Soc.*, 18, 1029-1044.—The author's results may be briefly summarized as follows: Antimony trioxide was completely volatilized when treated in an atmosphere of dry hydrochloric acid; lead oxide changed to chloride, volatile at 225° C.; bismuth oxide completely volatilized; copper oxide changed to chloride, if first moistened with hydrochloric acid and dried. By means of these reactions the separation of lead from antimony, lead from bismuth, antimony from copper, and bismuth from copper may be effected. The arsenic may be volatilized from the arseniates of sodium, copper, silver, cadmium, cobalt, and nickel. The separation of the arsenic from iron and zinc is difficult. The arsenic and nickel in niccolite were separated after solution in nitric acid and evaporation to dryness.

**The Separation of Vanadium from Arsenic.** By CHARLES FIELD, 3RD, AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, 18, 1051-1052.—Arsenic sulphide is completely volatilized from its mixture with vanadium sulphide without change of the latter, if treated in an atmosphere of dry hydrochloric acid, below 250° C. The separation may be utilized for quantitative analysis.

**The Separation of Manganese from Tungstic Acid.** By WALTER T. TAGGART AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, 18, 1053-1054.—The authors' results are entirely negative, sim-

ply showing that neither yellow ammonium sulphide nor potassium carbonate are suitable reagents to effect the separation of the elements named. They make the independent statement that molybdic sulphide may be easily converted to oxide by ignition with anhydrous oxalic acid, after drying.

**The Separation of Bismuth from Lead.** By ARTHUR L. BENKERT AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, 18, 1055-1056.—The authors find that a quantitative separation can be effected by double precipitation of the bismuth as a basic formate, from a formic acid solution.

**The Determination of Sulphur in Cast Iron.** By FRANCIS C. PHILLIPS. *J. Am. Chem. Soc.*, 18, 1079-1086.—The author finds that white iron may be completely oxidized, with the conversion of the sulphur to sulphates, by fusion of the finely divided iron with sodium peroxide or a mixture of sodium carbonate and sodium nitrate. Ferromanganese may be successfully oxidized by sodium carbonate and sodium nitrate. The percentages of sulphur determined by this method are apparently higher than by oxidation with nitric acid.

**Carbon Determinations in Pig Iron.** By BERTRAND S. SUMMERS. *J. Am. Chem. Soc.*, 18, 1087-1091.—The paper describes several devices to expedite the burning of large residues, for use in connection with the combustion apparatus, by means of which the most refractory residues may be burned in an hour and a half. The author finds the chromic acid method unreliable.

**Notes on the Solubility of Bismuth Sulphide in Alkaline Sulphides.** By GEORGE C. STONE. *J. Am. Chem. Soc.*, 18, 109.—The author finds that bismuth sulphide, which has been precipitated from acid solution, is not soluble in potassium or ammonium sulphide. Compare *J. Am. Chem. Soc.*, 18, 683.

**The Analysis of Coke.** By GEORGE C. DAVIS. *Am. Manufacturer*, 59, 804.—The author claims that the foundryman does not need to know the percentage of phosphorus in the coke used, but should know the percentage of ash and of sulphur. The usual proximate analysis of coke, and the Eschka method for sulphur determinations are imperfectly described, but the paper presents no new facts.

**On the Chemistry of the Cyanide Copper Assay.** By J. J. BERNINGER AND H. W. HUTCHIN. *Eng. Min. J.*, 62, 390-391.—The authors show that if potassium cyanide is added to a solution of copper sulphate, until the precipitate which first forms is just redissolved, and ammonia is then added, a blue

solution slowly forms. The color is intensified by the addition of ammonium nitrate. Increased quantities of ammonia, or ammonium salts do not necessarily intensify the reaction. A similar result was obtained if cupric cyanide is shaken with ammonia or ammonium nitrate. This may be decolorized by the addition of cyanide, but ammonia again restores the blue. The maximum quantity of cyanide was used in one case when only ammonia was present, in another where three-eighths of the ammonia was neutralized by hydrochloric acid. The reaction between the cupric cyanide and ammonia the authors express by the equation:  $2\text{Cu}(\text{CN})_2 + 6\text{NH}_3 + 2\text{H}_2\text{O} = 4\text{NH}_4\text{Cu}(\text{OH})_2 + (\text{NH}_4)_2\text{Cu}(\text{CN})_4$ , and they believe that their experiments and the general experience with the cyanide process suggest a "reversible reaction with a slowly attained state of equilibrium."

**On the Application of Certain Organic Acids to the Estimation of Vanadium.** By PHILIP E. BROWNING AND RICHARD J. GOODMAN. *Am. J. Sci.*, 152, 355-360.—The possibility of the estimation of vanadic acid by means of a standard iodine solution, (reduction having been effected by boiling with tartaric acid), is confirmed, and it is further shown that neither tungstic nor molybdic acids are reduced by tartaric acid in cold solution, and that tungstic acid is unaffected by either oxalic, tartaric, or citric acids in boiling solution, while citric acid reduces vanadium under these conditions. The general procedure is as follows: To a solution of vanadium, which may contain also a molybdate, or tungstate, add approximately one gram of acid (either tartaric, oxalate, or citric), for each one-tenth gram of substance. Heat the solution to boiling, unless tartaric acid is used in the presence of molybdates; in this case digest in the cold from fifteen to twenty hours. Add to the cold liquid five grams of potassium bicarbonate for each gram of acid used, add iodine solution and set aside until no further bleaching action is evident. Titrate for the excess of iodine with arsenious acid solution.

**The Determination of Oxygen in Air and in Aqueous Solution.** By D. ALBERT KREIDER. *Am. J. Sci.*, 152, 361-367.—The author adapts for these determinations a procedure already described by him (*Am. J. Sci.*, 150, 287), wherein oxygen is allowed to act upon a concentrated solution of hydriodic acid, in the presence of nitric oxide. The excess of the acid is neutralized by potassium bicarbonate and the liberated iodine titrated with arsenious oxide. For these determinations the author uses special forms of apparatus, which are described in detail in the original article, together with all necessary precautions.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

## REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### ANALYTICAL CHEMISTRY.

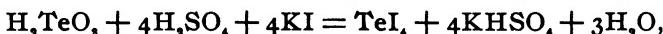
W. H. WALKER, REVIEWER.

**The Separation and Determination of Potassium and Sodium.**  
By D. ALBERT KREIDER AND J. E. BRECKENRIDGE. *Am. J. Sci.*, 152, 263-268.—The paper presents a qualitative method for the separation and detection of potassium and sodium based on the relative solubilities of the perchlorates. It has been shown that, while sodium perchlorate is readily soluble in 97 per cent. alcohol, the potassium salt is, on the contrary, insoluble in that menstruum. This paper provides a method by which sodium may be detected after it has been separated from the potassium, which is essentially as follows: To the filtrate from which all the bases, including ammonia, have been removed, 0.5 cc. of pure perchloric acid (sp. gr. 1.70) is added, and the solution is evaporated on the steam-bath until white fumes of perchloric acid appear. When the quantity of sodium is large it is safer to evaporate several times to secure complete conversion to the perchlorate. Upon treating with 97 per cent. alcohol, the presence of potassium is revealed by the existence of an insoluble residue, which is collected on a dry filter. When the filtrate is saturated with gaseous hydrochloric acid, sodium, if present in amounts greater than 0.0005 gram, will appear as a granular precipitate. The authors think the method is all that can be desired for qualitative determinations. Perchloric acid free from sodium was made by distilling (under a pressure of from 3 to 5 mm. of mercury) acid prepared according to the procedure described by Kreider, *Am. J. Sci.*, 149, 443). This must be done very slowly and in a specially prepared apparatus.

**Estimation of Cadmium as the Oxide.** By P. E. BROWNING AND L. C. JONES. *Am. J. Sci.*, 152, 269-270.—The authors

demonstrate the ease and accuracy with which cadmium carbonate may be ignited in a Gooch crucible and weighed as oxide, eliminating all danger of the reduction and subsequent volatilization of the cadmium. The precipitation is made in a hot aqueous solution by means of a ten per cent. potassium carbonate solution, and the liquid is boiled for ten or fifteen minutes until the precipitate becomes granular. It is then filtered upon asbestos, washed thoroughly, and ignited at a red heat to a constant weight. The results show a very small plus error, which the authors prove to be due to slight inclusions of the alkaline carbonate.

**The Determination of Tellurium by Precipitation as the Iodide.** By F. A. GOOCH AND W. C. MORGAN. *Am. J. Sci.*, 152, 271-272.—It has been already shown that when hydriodic acid and tellurous acid interact there is formed a tellurium tetraiodide which is converted by water into an oxyiodide, and by excess of an alkaline iodide into a soluble double salt. The authors show that this reaction takes place according to the equation:



and this is made the basis of a volumetric method for the direct determination of small amounts of tellurium. By shaking the flask the precipitate of tellurium tetraiodide, which at first separates in a finely divided condition, is made to gather into a curdy mass and so leave a clear supernatant liquid. Advantage is taken of this behavior, and the point at which the precipitation of all the tellurium is complete is not difficult to determine. In the test experiments, the tellurium dioxide was dissolved in potassium hydrate, and sulphuric acid of half strength was added in such an amount that at the end of the titration the solution should contain one-fourth its volume of strong sulphuric acid. This solution is then titrated with a decinormal potassium iodide solution, until a further addition gives no precipitate. Using 127 as the atomic weight of tellurium, the authors find this method satisfactory.

**Method for the Separation of Aluminum from Iron.** By F. A. GOOCH AND F. S. HAVENS. *Am. J. Sci.*, 152, 416-420.—When a cooled concentrated acid solution of aluminum and iron chlorides is saturated with gaseous hydrochloric acid, almost all the aluminum separates in fine white crystals of hydrated aluminum chloride,  $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$ , while all the iron remains in solution. On this difference in solubility is based a method of separation. The solubility of aluminum chloride in concentrated aqueous hydrochloric acid is very small, and is, moreover, greatly reduced by the addition of an equal volume of anhydrous ether. A complete separation seems to be most easily secured by mix-

ing the concentrated aqueous solution of the chlorides with enough concentrated hydrochloric acid to make the entire volume 15-25 cc., cooling to about 15° C. and passing into the solution gaseous hydrochloric acid. When completely saturated, the solution is mixed with an equal volume of anhydrous ether; and this mixture again saturated with gaseous hydrochloric acid. The crystalline precipitate of hydrous aluminum chloride is collected on asbestos in a perforated crucible and washed with a mixture of equal parts of aqueous hydrochloric acid and anhydrous ether saturated with the gas. When the precipitate is ignited directly, the mechanical loss occasioned by the rapid volatilization of the acid and water of crystallization is so great that it was found expedient either to dissolve in water and reprecipitate as hydroxide, or to cover the chloride with some volatile oxidizing agent before ignition. Mercuric oxide was found to serve the purpose well. The precipitate is dried for one-half hour at 150° C., covered with about one gram of mercuric oxide, first gently heated under a ventilating flue, and then freely over the blast lamp. The results seem to be satisfactory.

## PROXIMATE ANALYSIS.

A. H. GILL, REVIEWER.

**On the Determination of Stearic Acid in Fat.** By O. HEHNER AND C. A. MITCHELL. *J. Am. Chem. Soc.*, 19, 32-51.—The method prepared by the authors is a quantitative one, unlike the classical method of Heintz; it consists in dissolving out at 0° the other fatty acids by alcohol saturated with stearic acid, and in weighing the residue consisting of stearic acid.

**The Determination of Solid Fats in Compound Lards.** By G. F. TENNILLE. *J. Am. Chem. Soc.*, 19, 51-54.—The author shows that Wainwright's method at best cannot be depended upon for results closer than 1.5 per cent., and that, if the conditions are at all varied, the results may be 7 or 8 per cent. too high or too low.

F. H. THORP, REVIEWER.

**Volumetric Determination of Acetone.** By EDWARD R. SQUIBB. *J. Am. Chem. Soc.*, 18, 1068-1079; *Squibb's Ephemeris*, 4, 1759-1770.—This is a description of certain improvements in the process of J. Robineau and G. Rollin (*Moniteur Scientifique*, 41, 272-274), whereby greater simplicity, rapidity and ease of manipulation are secured, with sufficient accuracy for most purposes. The method is applicable to the determination of acetone in the presence of ethyl alcohol, and is especially recommended for use in testing the dilute solutions of acetone which are recovered by distillation in manufacturing operations, or in the

making of acetone itself. For the details of the process reference must be made to the original article.

G. W. ROLFE, REVIEWER.

**On the Conditions Affecting the Volumetric Determination of Starch by Means of a Solution of Iodine.** By F. T. LITTLETON. *Am. Chem. J.*, 19, 44-49.—The author has made an investigation of the colorimetric method proposed by Dermstedt and Voigtländer (abstracted in *The Analyst*, 20, p. 210), and finds that the process has very little analytical value, owing to the varying composition of the iodide of starch, possibly due to dissociation, under different conditions of temperature, solvents, etc.

W. R. WHITNEY, REVIEWER.

**A Modification of the Gunning Method for Nitrates.** By JOHN FIELDS. *J. Am. Chem. Soc.*, 18, 1102-1104.—The author claims to avoid the trouble caused by frothing in the Gunning method by gently heating the mixture of the sample with the sulphuric and salicylic acids, and then gradually adding 6-7 grams of potassium sulphide with shaking. The whole is boiled; and the digestion is usually complete in an hour. Distillation is then proceeded with as usual. Results have shown the modification to be as accurate as the Gunning method itself.

**Notes on the Estimation of Caffein.** By W. A. PUCKNER. *J. Am. Chem. Soc.*, 18, 978-981.—This is an experimental study of the extraction of caffein from dilute acid solutions by means of chloroform.

E. H. RICHARDS, REVIEWER.

**Methods for the Determination of Organic Matter in Air.** By DAVID HENDRICKS BERGEY. *Smithsonian Miscellaneous Collection*, 1037, 1-28. This publication is a critical compendium of the various methods proposed for the estimation of the organic impurities in air. The results lead to the conclusion that the dust in the air is the chief source of organic matter. The use of pumice has found greater favor with the author than the experience of the reviewer would warrant. Moreover, no notice is taken of the effect of the presence of nitrites in using permanganate.

**A Modification of the Babcock Method, and Apparatus for Testing Milk and Cream.** By J. M. BARTLETT. *Me. State College Agr. Expt. Sta., Bull.* 31, 1-8.—The author recommends adding hot water five minutes after mixing the sulphuric acid and milk or cream together, and claims that once whirling is then sufficient to cause the separation of the fat. The acid used (20 cc.) should have at 60° F. a specific gravity of 1.820-1.825, and the milk or cream (18 cc.) should be at a tempera-

ture of 70°–80° F., when it is mixed with the acid. A modified form of the graduated milk and cream bottles is also described.

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## TECHNICAL CHEMISTRY.

F. H. THORP, REVIEWER.

**The Manufacture and Use of Thomas Slag.** By F. E. THOMPSON. *Iron Age*, 59, 9.—The author first describes the treatment of the slag as made in the basic Bessemer process. Its value as a fertilizer is increased, if it is exposed to the weather several years before grinding; but it may be ground as soon as cold. It is prepared by grinding in a "ball-mill" until 90 per cent of it will pass a 100-mesh sieve. A series of sieving tests is given. The fertilizer value depends on the quantity of phosphoric acid present, and on its condition. In Thomas slag the phosphoric acid is present as tetracalcic phosphate, which is not so soluble in neutral ammonium citrate, as is "reverted" phosphate or dicalcic phosphate; but it is much less stable than tricalcic phosphate. The author then considers the causes of irregularities in the composition of the slag, which he charges to the method of running the converter. The methods of analysis of this slag are then discussed. From his investigations he concludes that neutral ammonium citrate does not give a correct estimate of the fertilizer value of the phosphoric acid; for it appears to dissolve the slag as a whole, and the per cent. of phosphoric acid dissolved bears a direct ratio to the total quantity of slag dissolved. Moreover, there is no evidence to show any difference between the phosphoric acid which it leaves in the slag and that which it dissolves out. Weathering appears to increase the solubility of the phosphoric acid in neutral ammonium citrate. The author considers Thomas slag to be a mixture of chemical compounds; for, if cooled slowly, several bodies separate as distinct crystals. According to recent reports, the slag is but slightly inferior as a fertilizer to dissolved bone or phosphate rock, and is superior to all insoluble phosphates.

**American Utilization Processes of Garbage Disposal.** By W. E. GARRIGUES. *Trans. Eng. Soc. Western Pa.*, 12, 266–276.—This is a condensed review of the system of garbage disposal in several large cities. The destructive processes are not discussed. The useful products obtained from garbage are grease and tankage. Grease is chiefly used for glycerine and candle stock. It will make only a very poor soap. Three systems of grease extraction are considered: with steam; by means of sulphuric acid; and by the use of naphtha. Tankage is used by the fertilizer manufacturers.

**Composition of American Kaolins.** By CHARLES F. MABERY AND OTIS T. KLOOZ. *J. Am. Chem. Soc.*, 18, 909-915.—This article consists chiefly of analyses of clays from various places in the United States. Two analyses of the kaolin used at the Royal Berlin porcelain works at Charlottenburg are included for comparison. Several of the American clays approach very nearly the composition of the German article.

**Chrome Tannage Patent.** By GEO. W. ALDER. *U. S. Pat. No. 573637.* (Abstract, *Leather Manufacturer*, 7, 19).—The chrome solution is prepared by dissolving potassium or sodium bichromate in an excess of sulphuric acid diluted with two volumes of water, reducing the chromium salt by the addition of sugar or alcohol, then neutralizing and precipitating chromium hydrate and "chromium oxycarbonate" by the addition of sodium carbonate, and finally dissolving the precipitate, without filtering, by the addition of hydrochloric acid to the mixture. The resulting liquor is supposed to contain chromium chloride, chromium sulphate, sodium and potassium sulphates, sodium chloride, and either formates or acetates of these metals.

**Chrome Tannage Patent.** By HUGO SCHWEITZER. (Abstract *Leather Manufacturer*, 7, 20.)—The process consists in the "reduction on the animal fiber of bichromate of potash by means of hydroxylamine compounds, such as hydroxylamine, its sulpho acids and salts, in the presence or absence of any of the nitrogen-sulphone acids, which are formed to some extent in the reaction, which produces sulpho acids of hydroxylamine, thereby permitting the use of neutral, weakly acid or weakly alkaline solutions for the second bath."

**Chrome Tannage Patent.** By ROBERT WAGNER AND J. J. MAIER. *U. S. Pat. No. 574014.* (Abstract *Leather Manufacturer*, 7, 19.)—This is a one-bath chrome tannage process. It is proposed to take ten pounds of chrome alum, three pounds of saltpeter, six pounds of muriatic acid, fifteen pounds of salt, and ten pounds of whiting, and mix them with fifteen gallons of water. The whiting and salt are first mixed together (dry?) at a temperature of 70° (F?), and then the other ingredients are added and the whole stirred into the water.

**Manufacture and Development of Carborundum at Niagara Falls.** By FRANCIS A. FITZGERALD. *J. Franklin Inst.*, 143, 81-96.—After a discussion of the early forms of furnace, the author takes up the subject of the manufacture at Niagara. The materials used are sand, coke, sawdust, and salt. These are properly mixed and filled into an oblong brick furnace 16x5x15 feet, in the ends of which are the terminals consisting of 60 carbon rods 30 inches long and 3 inches in diameter. Con-

nexion between each carbon and the end plate is made with  $\frac{1}{8}$  inch copper rod. The side walls of the furnace are built up each time a charge is introduced. The current used in the furnace at first is about 1200 amperes; but after the charge becomes hot the resistance decreases, and at the end of an hour the current is such that 746 kilowatts (or 1000 horse-power) are being used in heating the furnace. As the current increases, the electromotive force is reduced, until finally the resistance becomes constant. No apparent change is observed for half an hour; but then inflammable gases begin to escape from the furnace. After three or four hours the top of the furnace is covered by blue flames of carbon monoxide, which escapes in great quantities. After twenty-four hours the current is cut off, and the furnace cools. The side walls are removed; and the unchanged, loose mixture is raked off. The core is crystalline at the center; and about 4000 pounds of crystalline carborundum are obtained from one furnace. The carborundum is crushed, treated with dilute sulphuric acid, washed, and dried. After sifting it is ready for use. Carborundum is infusible, decomposing without melting; it is insoluble in water and acids; it has a hardness near 10; and its specific gravity is 3.23. It is replacing emery for many purposes.

**Manufacture of Oxygen.** By MR. LINTON. *Proc. Eng. Soc. Western Pa.*, 12, 222-231.—This is a review of the commercial methods of making oxygen, with special reference to the process of E. B. Stuart, of Chicago. It is similar to the Tessie du Motay process; but it is claimed that it avoids some of the difficulties of that method. A mixture of caustic soda and black oxide of manganese is heated to 500°-600° F., and the air is blown through it, by which process sodium manganate is formed. Steam is then blown through the mass, which dissociates the manganate, forming caustic soda, manganese binoxide and oxygen. The air is blown in for ten minutes and the steam for five minutes. The manganate mass obtained consists of one part manganate to two of caustic soda. It fuses to a liquid at the temperature of the reaction, which is carried on in cast iron retorts, set vertically. Each retort is charged with 1500 pounds of the mixture, and the two retorts yield 76,000 cubic feet of gas in twenty-four hours, at a cost of 7 cents per 1000 cubic feet.

**Second International Congress of Applied Chemistry.** By H. W. WILEY. *J. Am. Chem. Soc.*, 18, 923.—This is a review of the proceedings of the meeting held at Paris, in July and August, 1896.

A. H. GILL, REVIEWER.

**Some Facts about Acetylene Gas.** By J. C. M'MYNN.

*Electr. Eng.*, 21, 197-198.—This is a concise statement of the present knowledge of the subject.

**Fuels.** By A. V. ABBOTT AND F. J. DOMMERQUE. *Electr. Eng.*, 9, 1-186.—This article deals succinctly with the origin, distribution, production and composition of the various fuels—wood, peat, coal, petroleum and gas, and discusses the advantages of each. A special and valuable feature of the treatise is the numerous tables and plots which it contains. The methods of proximate fuel analysis and of manipulating the Carpenter calorimeter, the Mahler bomb, and the Elliott gas apparatus are also given—in some cases, however, with insufficient detail as to their execution. As the article does not present original material, this reference to it will suffice.

**The Testing of Coals.** By ARTHUR WINSLOW. *J. Assoc. Eng. Soc.*, 17, 84.—The paper is the outline of a plan of the author to study the North American coals, considering their adaptability for: (1) Steaming; (2) Coke making; (3) Domestic use; (4) Gas making; and (5) Blacksmithing. This article gives the properties of coals adapted to each of these uses. The investigation will be an interesting and exceedingly important one—one almost beyond the power of any one man to execute. A comparison of the calorific power as obtained by the calorimeter and by the Dulong formula would be very instructive. It is to be regretted that the Barrus calorimeter is to be used for the determination of the calorific power, as its results may vary as much as three per cent. from those obtained by the Mahler apparatus.

G. W. ROLFE, REVIEWER.

**A Study of the Clarification of Sugar Cane Juices.** By J. L. BEESON. *J. Am. Chem. Soc.*, 19, 56-61.—This paper is related to those previously published (*La. Sta., Bull.* 38; *this Rev.*, 2, 110.). In an investigation of the commercial process of clarification ("defecation,") as applied to cane juices, the author finds that the gums and albuminoids of the juice fall into three classes: (a) those which form insoluble compounds with lime; (b) those which are precipitated by heat; and (c) those which are not rendered insoluble by either lime or heat. The latter class, however, can be precipitated by suitable reagents, and are found to comprise nearly one-half of the total amount of gums and albuminoids.

#### BIOLOGICAL CHEMISTRY.

W. R. WHITNEY, REVIEWER.

**The Tannin of Some Acorns.** By HENRY TRIMBLE. *Am.*

*J. Pharm.*, 68, 601-604.—The author has determined the tannin, moisture, and ash in different parts of the chestnut-oak acorn (*Quercus Prinus*) during the month of September when ripening occurs. As few comparative results are given, no important conclusions can be drawn as to the change in the quantity of tannin in different parts of the fruit during growth. The greatest amount of tannin comes from the testa, where over 48 per cent. was found. A comparison of the tannin of the cupule with that from many samples of oak bark was made, and analyses of both were carried out. The two are evidently identical. The article concludes with the results of the analyses of six different samples of acorn cupules.

**Alfalfa.** By WILLIAM P. HEADDEN. *Col. Agr. Expt. Sta.; Bull.* 35, 1-92.—The author gives the results of his study of the plant, embracing analyses of each of the three cuttings of a season, and showing the amount and composition of the ash of the whole plant above ground at different degrees of maturity. Analyses were also made of the separate parts of the plant, the soil, etc. The analyses included determinations of moisture, ash, ether extract, crude protein, crude fiber, nitrogen-free extract, and amide nitrogen. Complete analyses of the ash are also given. In an appendix the methods of analysis and of the preparation of the samples are described, and a compilation of fodder analyses is given.

**Rectification of Turpentine Oil.** By EDWARD KREMERS. *Pharm. Rev.*, 15, 7.—The author has carefully fractionated the commercial product after treating it with milk of lime. Tables giving the specific gravity and rotatory power of the fractions are given. He notes also that the rectified product undergoes the so-called resinification on standing.

**The Caffein Compounds of Kola.** By JAMES W. T. KNOX AND ALBERT B. PRESCOTT. *J. Am. Chem. Soc.*, 19, 63-90; *Am. Pharm. Assoc. Proc.*, 1896.—This article gives an abstract of the existing chemical literature on kola, describes in detail methods for the determination of its free and combined alkaloids (chiefly caffein), presents analytical results obtained with different samples, and describes the separation, properties, composition, and artificial preparation of the glucoside present in kola.

**The Chemistry of the Cotton Plant.** By J. B. McBRIDE AND W. H. BEAL. *U. S. Dept. Agr., Bull.* 33, 81-142.—This article shows the fertilizing and proximate constituents of all parts of the cotton plant—the roots, stems, leaves, bolls, lint, seeds, etc. Tables containing the results of hundreds of analyses are given, the entire subject having been very thoroughly treated.

**Purification of Natural Cumarin.** By EDO CLAASSEN. *Pharm. Rev.*, 15, 28.—The crude cumarin is treated with hot benzine (sp. gr. 0.71), from which it crystallizes on cooling. The final portion of cumarin is separated from the benzine solution by shaking this with a five per cent. sodium hydrate solution.

**On the Occurrence of Sulphur Derivatives in American Peppermint Oil.** By CLEMENS KLEBER. *Pharm. Rev.*, 14, 269.—The author shows the presence of dimethyl sulphide in American peppermint oil.

**Terpin Hydrate.** By EDWARD T. HAHN. *Am. J. Pharm.*, 69, 73-75.—This short article contains a resumé of the methods for the production of terpin hydrate from turpentine. The author finds that by using oil of turpentine, methyl alcohol (sp. gr. 0.801) and nitric acid (sp. gr. 1.35) in the volume proportions 4 : 1 : 1, a satisfactory yield of the crystalline product is most quickly obtained. The crystallization is hastened by the addition of one volume of water after the reaction is complete.

**A Contribution to the Knowledge of Some North American Coniferae.** By EDGAR S. BASTIN AND HENRY TRIMBLE. *Am. J. Pharm.*, 69, 90.—This portion of the work treats of the hemlock (*Tsuga Canadensis*). Samples of the bark were analyzed by fractional extraction, and the tannin also determined. Pure hemlock tannin was isolated and analyzed; the results show it to be unexpectedly high in carbon and hydrogen and are not in agreement with the formula proposed by Boettiger,  $C_{20}H_{18}O_{10}$ . The authors found nearly half a per cent. more carbon in the hemlock tannin than in any one of ten oak tannins examined.

**Chemical Analysis of the Bark of Honey Locust (*Gleditschia Triacanthos*).** By LOUIS P. CARSTENS. *Am. J. Pharm.*, 69, 40-41.—This article contains the results of the analysis by the usual extraction methods of a sample of the bark mentioned in the title. The alkaloid extracted with 95 per cent. alcohol was removed from the solution by chloroform, and crystallized from absolute alcohol.

**Assay of Johore Gambier.** By W. O. RICHTMANN. *Pharm. Rev.*, 15, 27-28.—Results of analyses of six different samples are given, showing the amounts of moisture, ash, tannin, and catechin present. The author suggests that possibly a definite relation exists between the amounts of catechin and tannin in different gambiers; for a low quantity of the one seems to occur where there is a relatively large quantity of the other. The conversion of one into the other may be brought about, he believes, by some vegetable organism.

**Concerning Properties Belonging to the Alcohol Soluble Proteid of Wheat and of Certain Other Cereal Grains.** By G. L. TELLER. *Am. Chem. J.*, 19, 59-61; *Ark. Agr. Expt. Sta., Bull.* 42, 75-104.—In working with the proteids in wheat, the author observed that some nitrogen-containing substance was soluble both in dilute salt solution and in the 75 per cent. alcohol usually employed. This substance was shown to be a proteid by the usual reactions. Analyses of twenty different samples of wheat and other mill products showed that the nitrogen-content of this soluble proteid was practically the same in each case, while the other nitrogenous constituents varied considerably. The author believes the proteid to be gliadin. It has many of the properties of proteoses; but it is readily soluble in 75 per cent. alcohol, and from this solution it is not precipitated by common salt. The same or a similar body was found in the alcohol extracts of oats, rye, and barley. The experiments are more fully described, and detailed methods for the quantitative separation of the proteid are given in the *Bulletin*.

**The Action of Enzymic Ferments upon Starches of Different Origins.** By WINTHROP E. STONE. *U. S. Dept. Agr., Bull.* 34, 29-44.—The author's belief that starches from different sources are not identical, but that there are isomeric starches as there are isomeric sugars, is supported by experiments on the relative rates of decomposition of maize, wheat, rice, potato, and sweet potato starches, usually in the gelatinized state, by the enzymic ferments—malt diastase, ptyalin from human saliva, and pancreatin from beeves and swine. It was found that the time required for the complete decomposition of the different starches as determined by the failure of the iodine test, varied greatly with the source of the starch in the case of each of the ferments, and that the orders of susceptibility of the different starches to the various enzymes were also widely different.

G. W. ROLFE, REVIEWER.

**The Carbohydrates of Wheat, Maize, Flour and Bread.** By W. E. STONE. *U. S. Dept. Agr., Office of Exp. Sta., Bull.* 34, 7-28.—A large amount of analytical data is given comprising estimations not only of the carbohydrates—the more common polysaccharides, hexoses and pentose derivatives—but also of ash, fat, fiber, and proteids. The change of composition, due to milling and baking, are discussed in considerable detail, the views in general conforming to the opinions usually accepted. The most extraordinary feature of the paper is the remarkable starch showing. The author finds by his analyses that the starch-content of the cereals are from 20-30 per cent. lower than the figures generally given. What is yet more strange is that

the figures of the other components show a practical agreement with the results of other investigators, so that a deficit of over 20 per cent. is left to be accounted for. This fact the author does not explain, but leaves us to infer that this large fraction of the grain is in reality totally overlooked in our usual methods of investigation, the discrepancy presumably being marked by the too high results of faulty starch determinations. Aside from an opinion that this missing material is not carbohydrate nor indeed food, the author gives no hint as to its nature, not even attempting a separation by solvents or other rough method of classification to throw light upon the mystery. It is certainly most remarkable if we are to believe that in the present state of the science practically a quarter of our common cereals consists of material in regard to whose nature we have not the most primitive ideas! In consideration of the importance of the matter and of the disagreement of the results with those of previous investigators, the reviewer suggests that a more complete and detailed explanation of the author's method of starch determination would have been most acceptable to his readers. Confidence in the results would have been greatly increased by statements in regard to the amount of reducible carbohydrates produced by the presence of the malt infusion, apparently no inconsiderable fraction of the whole; in regard to the methods of correction, the details of the Fehling test, the precautions taken by the author to satisfy himself that the final acid hydrolysis actually converted the carbohydrate to dextrose; and in regard to other minor points.

F. H. THORP, REVIEWER.

**Mineral Constituents of the Watermelon.** By G. F. PAYNE. *J. Am. Chem. Soc.*, 18, 1061-1063.—**The Ash Analysis of the Watermelon, giving the Mineral Substances It Takes from the Soil.** By G. F. PAYNE. *Ga. Dept. Agr. Bull.* No. 32, 29-31. Two melons gave, on analysis, 0.33 per cent. of ash, which was itself analyzed. The author concludes that a crop of 39,766 pounds per acre (which is three times the average yield per acre) takes from the soil 81.09 pounds of potash and 13.59 pounds of phosphoric acid.

**The Use of Arsenites on Tobacco.** By H. GARMAN. *Ky. Sta. Bull.* 63, 68-80.—This investigation is a study of the effect of spraying tobacco with Paris green. Samples of the dry tobacco were analyzed; and arsenic was found in all of them in amounts ranging from "traces" to 0.0139 per cent. As<sub>2</sub>O<sub>3</sub>. The question of danger to the consumer is not settled, but it is thought that no serious injury can result from the use of arsenites. Data as to the best time for spraying, the amount to use, and the quantity received by each plant, are also given.

**Report of the Section on Agriculture and Chemistry.** *Proc. Ninth Ann. Convention Assoc. Am. Agr. Coll. Exp. Sta., U. S. Dept. Agr., Bull. 30, 10-14.*—This bulletin gives a short summary of the work of the several experiment stations, during the year 1896, in agricultural and chemical studies.

**Bordeaux Mixture, Its Chemistry, Physical Properties, and Toxic Effects on Fungi and Algae.** By W. T. SWINGLE. *U. S. Dept. Agr., Div. Vegetable Physiology and Pathology, Bull. 9.*—Bordeaux mixture is said to be a mixture of calcium sulphate and cupric hydroxide, suspended in an aqueous solution of calcium sulphate and calcium hydrate. When freshly made, the cupric hydrate is of a colloidal nature, but on standing it becomes crystalline. The copper, even when in a very dilute condition, exerts a very destructive action on the germinating power of fungus spores and upon algae.

**The Real Value of "Natural Plant Food."** By L. L. VAN SLYKE. *N. Y. Agr. Exp. Sta., Bull. 108.*—The article is a warning against a certain fertilizer manufactured by the Natural Plant Food Co., of Washington, D. C. Analysis of the material shows it to be a very inferior article.

**Analyses of Commercial Fertilizers.** *Agr. Expt. Sta. Bull., Ga. Dept. Agr., No. 32; Ky., Nos. 60 and 64; Mass. Hatch Sta., No. 42; Me., Nos. 22 and 30; N. C., Special Bull. Nos. 37 and 38; also Bull. 124; N. J., No. 113; N. Y., Nos. 96 and 107; Pa. Dept. Agr., No. 11; Purdue Univ., Special Bulls., May and August, 1896; R. I., No. 34; W. Va., No. 40; Md., No. 40.*

W. R. WHITNEY, REVIEWER.

**Reduction of Nitrates by Bacteria and Consequent Loss of Nitrogen.** By ELLEN H. RICHARDS AND GEORGE WILLIAM ROLFE. *Tech. Quart., 9, 40-59.* The authors found that the nitrogen of potassium nitrate, in water containing a tenth of a per cent. of milk was in some way lost in the cycle of changes: nitrate, albuminoid ammonia, free ammonia, nitrite, nitrate, after entering the nitrite stage. Investigation showed that the organisms growing in the solution generated nitrogen gas during their growth, and that practically all of the previously missing nitrogen of the nitrate was thus accounted for. The article concludes with some interesting suggestions concerning the storage of nitrogen in soils and waters.

**The Excretion of Metabolized Nitrogen by Animals.** By C. F. LANGWORTHY. *U. S. Dept. Agr. Exp. Sta. Record, 7, 817-825.*—This article is a summary of the principal results of other

experimenters upon the part played by nitrogen in the nutrition of animals.

**On the Behavior of Coal-Tar Colors toward the Process of Digestion.** By H. A. WEBER. *J. Am. Chem. Soc.*, 18, 1092-1097.—The digestive actions of pepsin and pancreatin when acting upon fibrin, in the presence of oroline yellow, saffoline, magenta, and methyl orange, were separately studied. Of these colors only oroline yellow retarded the action of the pepsin; but saffoline, magenta, and methyl orange interfered very seriously with the fermenting action of pancreatin. The use of such colors in articles of food and drink is therefore objectionable.

**The Formation of Fat in the Animal Body.** By SELIK SOSKIN. *U. S. Expt. Sta. Record*, 18, 179-192.—This article gives a historical account of investigation since 1742, made to discover the source of the fat in the animal body. It concludes with the acceptance of Pflüger's results and conclusions as opposed to those of Pettenkoffer and Voit, who believed that fat could be produced in the animal system from proteids alone.

E. H. RICHARDS, REVIEWER.

**Food and Nutrition Investigations in New Jersey in 1895 and 1896.** By EDWARD B. VOORHEES. *U. S. Dept. Agr. Expt. Sta., Bull.* 35, 7-40.—This report deals mainly with the composition and cost of bread and of milk. Analyses are given of 139 samples of fresh bread and of 108 samples of milk. The work done on bread shows that while wheat and wheat flour may be considered as standard articles, bread made from the same flour may have a varying nutritive value. The results of a dietary study of a mechanic's family are also recorded.

**Milk Fat and Cheese Yield.** By L. L. VAN SLYKE.—*N. Y. Agr. Expt. Sta., Bull.* 110, 251-280.—The author presents the results of a very large number of determinations of the relation of the amount of fat to the amount of casein in milk and to the yield of cheese obtained from it. Milk from fifty different herds of cows was examined during a period of six months. The experiments show that *in general* milk fat and casein increase simultaneously; but that the increase of the former is usually relatively greater than that of the latter. This is shown by the following table, in which are given the general averages for milks containing 3 and 4 per cent. of fat, respectively:

Per cent. fat.	Per cent. casein.	Ratio of casein to fat.	Percentage yield of cheese.	Ratio of cheese yield to fat.
3.00	2.10	0.70	8.55	2.85
4.00	2.40	0.60	10.40	2.60

Although the ratio of cheese yield to fat is somewhat greater

in the case of the milks poorer in fat, yet the quality of cheese produced is proportionately poorer, so that the author concludes from these results that milk fat forms the fairest practicable basis to use in paying for milk for cheese making—that in no case should it be paid for by weight of milk alone, and that payment by cheese yield gives an unfair advantage to poor milk.

**Analyses of Some Substances Sold as Cream of Tartar.** By G. F. PAYNE. *Ga. Dept. Agr., Bull.* 32, 24-28.—Of ten samples purchased and analyzed, five contained no cream of tartar, two contained less than 57 per cent., and one less than 80 per cent.

**The Study of Human Foods and Practical Dietetics.** By M. E. JAFFA. *Univ. Cal. Agr. Expt. Sta., Bull.* 110, 3-19.—The title is sufficiently descriptive of the general character of this bulletin. It is for the most part based upon previously published work; but it contains the following valuable results, expressed in per cent., calculated from original analyses of California fruit, nuts, and bread stuffs.

	Total Water.	nutrients.	Protein.	Fats.	Carbo- hydrates.	Mineral matters.	Fuel value of one ounce.
Wheat flour...	12.5	87.5	8.0	1.1	77.9	0.5	102
Graham flour .	12.1	87.9	8.5	1.9	75.8	1.5	103
Bread.....	32.3	67.7	6.4	1.7	58.7	0.9	80
Apples.....	83.2	16.8	0.2	0.4	15.9	0.3	20
Oranges .....	88.0	12.0	0.8	11.2	..	..	14
Prunes (all) ..	80.0	20.0	0.8	18.7	..	0.5	23
Apricots .....	85.0	15.0	1.0	13.5	..	0.5	18
Figs .....	79.0	21.0	1.5	18.9	..	0.6	24
Grapes.....	80.0	20.0	1.3	18.2	..	0.5	23
Olives .....	58.0	42.0	1.1	27.6	11.6	1.7	88
Walnuts .....	2.5	97.5	14.3	65.9	16.3	1.0	202
Almonds.....	5.3	94.7	17.6	56.2	19.1	1.8	191
Peanuts.....	8.0	92.0	28.0	40.0	23.0	2.0	164

## APPARATUS.

A. H. GILL, REVIEWER.

**A New Form of Potash Bulb.** By M. GOMBERG. *J. Am. Chem. Soc.*, 18, 941. The bulb is shaped like a small Erlenmeyer flask and divided into three compartments. It is much less fragile than the usual form; and it will stand upon the balance pan. It is, however, difficult to manufacture; and whether it presents a sufficient surface for absorption is questionable.

**A Rapid Measuring Pipette.** By E. L. SMITH. *J. Am. Chem. Soc.*, 18, 905.—The apparatus described seems to be fairly accurate, to admit of rapid work and to be easily made.

**A Simple and Convenient Extraction Apparatus for Food Stuff Analysis.** By J. L. BEESON. *J. Am. Chem. Soc.*, 18, 744-745. The apparatus is an adaptation of the Johnston extractor, this being provided with a ground-glass stopper, which is closed with a rubber cap while weighing. The stopper is funnel shaped, and during the extraction it is inverted in the extraction tube, thus directing the solvent to the center of the sample and preventing loss by spattering.

**On a Simple Automatic Sprengel Pump.** By B. B. BOLTWOOD. *Am. Chem. J.*, 19, 77-78.—The apparatus makes use of a water jet pump to draw the mercury through the Sprengel tube. In course of ten minutes operation vacua suitable for the display of electrical phenomena are obtained.

**On Some New Forms of Gas Generators.** By T. H. NORTON. *J. Am. Chem. Soc.*, 18, 1057-1061.—The article shows how common laboratory apparatus may be utilized for this purpose.

**A Modified Form of the Ebullioscope.** By H. W. WILEY. *J. Am. Chem. Soc.*, 18, 1063-1067.

**A New Electrolytic Generator for Oxygen and Hydrogen.** By W. S. FRANKLIN. *Phys. Rev.*, 4, 61.—The generator consists of a number of massive frames of an alloy of lead with four per cent. of antimony, bolted together and insulated from each other by rubber diaphragms. The gases are prevented from mixing by glass strips. The generator requires 19 volts per cell, the current through each cell being 24.6 amperes. The maximum purity of the hydrogen was 94.8 per cent.; that of the oxygen 86.2 per cent. The efficiency of the generator is about 36 per cent. It gives 660 liters of hydrogen and 330 liters of oxygen per hour, at a cost of about 80 cents, which is 8 cents per cubic foot of oxygen.

**The Practical Use in the Chemical Laboratory of the Electric Arc Obtained from the Low Potential Alternating Current.** By M. S. WALKER. *Am. Chem. J.*, 18, 323-328.—The arc may be used: (1) To show the effect of high temperatures upon difficultly fusible and volatile substances; (2) for the reduction of metallic oxides; (3) blowpipe analysis; and (4) for the preparation of some compounds of carbon from the elements. The article describes the apparatus and methods to be employed in these various applications.

**A New Form of Pyknometer.** By J. C. BOOR. *J. Am. Chem. Soc.*, 19, 61-62.—The usual bottle form is vacuum jacketed to prevent the troublesome expansion of the liquid during weighing and its outflow through the capillary.

nary matting to 90 per cent. in true pyritic smelting, shall be taken into consideration; (5) the chemical composition of the matte shall be ascertained; for, besides all the copper, three-fourths of the lead and one-half of the zinc enter it, the rest of the available sulphur combining with iron; (6) the total weight of the charge shall bear a certain relation to the size and working of the blast furnace, the figures varying from 2000 to 4000 pounds; (7) the percentage of fuel shall be correctly apportioned, from 10 to 15 per cent. of coke, (12 per cent. ash), if little sulphur is oxidized, the percentage being on the sum of ore and flux; (8) the loss in gold, silver and copper shall not exceed permissible amounts, *viz.*, loss in gold *nil*, in silver 95 per cent.; with 40-50 per cent. matte the slag shall not contain over 0.6 per cent. copper. Three examples show how these general considerations are followed under special conditions.

**Improvements in the Electrolytic Refining of Copper.**  
By T. ULKE. *Eng. Min. J.*, 62, 464-565. The author states that it is generally conceded now that the Farmer or Hayden process (arranging the plates in series without separate cathodes) is less satisfactory than the common multiple process and that the former is no longer used to any extent except at the works of the Baltimore Electric Refining Co. He further describes the method of circulating the electrolyte in use at the copper refining works of M. Guggenheim's Sons, at Perth Amboy, N.J., which is a slight modification by Schneider and Szontag of the one used for many years by Borchers Bros., Goslar, Prussia (see Borchers, *Electrometallurgie*, 1895, p. 185).

**Present Method of Treating Slimes from Copper Refineries.** By T. ULKE. *Eng. Min. J.*, 62, 512.—The slimes from electrolytic copper refineries, amounting to about 4 per cent. of the weight of the anode, contain, after the scrap copper has been screened off, 15-30 per cent. copper, 45-50 per cent. silver, less than 1 per cent. gold, and 20-35 per cent. of impurities, made up of lead, bismuth, arsenic, antimony, and tellurium. In some works, which have a lead plant in addition to a copper plant, the slimes are added either to the softening furnaces treating comparatively low-grade blast furnace lead or to the cupelling furnaces working the enriched lead. In other plants the slimes are first refined in the wet way and then in the dry way. Thus, at the Baltimore Electric Refining Co's works the screened slimes are boiled for three or four hours in dilute sulphuric acid (1:4) using a Körting injector, dried, melted down, and refined in a cupelling furnace. In the furnace at first a brownish slag with 20 per cent. lead and 10 per cent. antimony forms on the surface; it is drawn, cooled, picked over for prills of silver, and worked off with lead in a separate cupelling furnace. Then niter

is spread over the precious-metal bath in the furnace, which refines the metal, forming a second slag, to be drawn off, containing as much as 20 per cent. tellurium. The doré silver is now ready to be cast into bars for parting.

**The Separation of Nickel and Copper in Matte and the Recovery of the Contained Precious Metals.** By T. ULKE. *Eng. Min. J.*, 63, 113-114.—The author gives a brief review of a number of processes for treating nickel-copper matte in the wet way, and a short outline of an electrolysis method of his own. Electrolytic refining of matte has so far always been a failure, and the method proposed does not show, as far as can be judged from the details given, why it should not share the same fate as its predecessors.

**The Brown Patent Automatic Pulp Distributor.** By H. P. BROWN. *Eng. Min. J.*, 62, 512-513.—This article refers to a simple mechanical devise for distributing the pulp cheaply, evenly, and loosely in the large leaching tanks (diameter 24-26 feet, depth 5-6 feet) of gold and silver mills.

**Purification of Sodium Hyposulphite Solutions.** By A. R. P. *Eng. Min. J.*, 63, 63.—The author calls attention to the good results obtained in leaching silver ores with sodium hyposulphite after having freed this solvent from sodium sulphate by acidulating and over-precipitating with calcium sulphide. In regular work he uses sodium sulphide to precipitate the metals, and at the same time to convert sodium tetrathionate (formed in making Russell solution) into hyposulphite, he then follows this up by using calcium sulphide to eliminate obnoxious sodium sulphate as harmless calcium sulphate. It may be recalled in this connection that Ottokar Hofmann has always advocated the use of sodium hyposulphite as a solvent in combination with calcium sulphide as precipitant.

**The Cyanide Process.** By A. D. NORDHOFF. *Min. Sci. Press*, 73, 441.—A complete list of the books and papers on the subject contained in the library of the University of California.

**The Cyanide Process for the Treatment of Gold Ores.** By J. W. RICHARDS. *J. Franklin Inst.*, 143, 96-109.—This paper is a short review of the MacArthur-Forrest process, giving its development and chemistry, and describing some of the work that is being done in treating telluride ores in Colorado and native gold ores in Utah and the Transvaal.

**Apparatus for the Electrolysis of Hydrochloric Acid.** By GEO. O. HIGLEY AND B. T. HOWARD. *Am. Chem. J.*, 18, 587. The apparatus is a modification of that of Hofmann, so arranged that the hydrogen and chlorine are generated in separate vessels and traverse but a small layer of liquid. It is said to be very simple and accurate.

**Apparatus for Distillation in a Vacuum.** By P. C. FREER. *Am. Chem. J.*, 18, 584.—A modification of the Kahlbaum receiver, so arranged that the entire top can be covered with mercury, thus effectually preventing leakage.

**Apparatus for Showing the Composition of Water.** By P. C. FREER. *Am. Chem. J.*, 18, 584.—A modification of the Hofmann apparatus so arranged that the explosion can take place under diminished pressure and prevent the shattering of the tube.

## METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

**A Hot-Blast System for Copper Matting and Silver-Lead Furnaces.** By J. A. NESMITH. *Min. Sci. Press*, 73, 318.—The air on its way from the blower to the blast furnace passes through a chamber in which a jet of oil or gas is kept burning. The products of combustion become mixed with the air, superheat it, and pass off with it. The reason for allowing a mixture of carbon dioxide and air to enter the furnace is that the air having been superheated is more active and less of it is required in the blast furnace for oxidizing the fuel; hence dilution with carbon dioxide has no bad effect. On the other hand superheated air of such a composition will not have the tendency to localize the heat as would superheated pure air, but will distribute it. It seems to the reviewer that this method of working is not based upon correct principles. If the blast is to be superheated by the combustion of extraneous fuel, why undo the good effect by diluting with carbon dioxide? If the effect of the air superheated in the usual way is too strong, cut down the coke in the blast furnace, and this will weaken it in an economical way. Blowing large volumes of weak air through a furnace can only have the effect of making the heat creep up and give a hot top. While perhaps desirable in pyritic smelting, this is fatal to lead smelting. It would appear as if the relative prices of coke and of bituminous coal, oil, or gas would have to decide whether the blast is to be superheated or not; but if superheated, the products of combustion must be kept separate from the blast furnace air.

**The Percentage of Zinc in Slags.** By E. A. WEINBERG. *Eng. Min. J.*, 57, 580.—The paper gives some facts obtained by the author in smelting roasted sulphide lead ore, rich in zinc, in a small water-jacket blast furnace. The best slag made contained :  $\text{SiO}_2$ , 32 per cent.,  $\text{FeO}$ , 31 ;  $\text{CaO}$ , 7 ;  $\text{Al}_2\text{O}_3$ , 8.5,  $\text{ZnO}$ , 18.5 ; the rest being lead, copper, sulphur, and alkali ; the matte assayed as high as 22 per cent. of zinc and was very rich in lead and copper.

**Granulating Matte.** By S. E. BRETHERTON. *Eng. Min. J.*, 63, 43.—This is a short note outlining the method of granulating blast furnace matte at the works of the American Smelting Co., Leadville, Col. Granulated matte appears to roast more easily than when it has been crushed, rolled and screened, as is the common practice ; further, granulating is much cheaper than any other method of comminuting.

**Wall Accretions of Lead Blast Furnaces.** By M. W. ILES. *School Mines Quart.*, 18, 18-23.—This is a brief discussion of how wall accretions are formed in the lead blast furnace, what their general character is, and how their formation may be lessened, as it is not possible to avoid them entirely. An average analysis gave the following figures :  $\text{SiO}_2$ , 17.26 ; Fe, 13.26 ; Mn, 1.60 ;  $\text{CaO}$ , 3.20 ; S, 10.90 ; Zn, 18.42 ; Cu, 0.80 ; an average of all the assays made at the works under the author's charge in seventeen years : Pb 24.06 per cent., Ag 29.74 ounces and Au 0.197 ounce per ton. Wall accretions are formed mainly by the volatilization and condensation of metallic sulphides ; these are often oxidized to some extent after deposition. The other constituents are particles of the charge that have during the descent become mechanically lodged in the accretion and may have undergone a chemical change later. For the practical details the reader is referred to the paper.

**The Calculation of Copper-Matte Blast Furnace Charges.** By H. VAN F. FURMAN. *School Mines Quart.*, 18, 1-13.—As in a previous paper on a calculation of lead blast furnace charges, (*op. cit.*, 14, 134-148,) the author discusses first the general principles and then illustrates them by carrying out calculations in detail. The leading principles are that (1) the slag produced shall be good from a metallurgical and economical point of view, the range of composition being :  $\text{SiO}_2$ , 26-45 ;  $\text{Al}_2\text{O}_3$ , 0-20 ;  $\text{FeO}$ , 28-65 ;  $\text{CaO}$ , 0-28 ;  $\text{ZnO}$ , 0-14 ; and of specific gravity 3.50-3.75 ; (2) the different ores shall be used up in about the same proportions as they are received ; (3) the matte shall be of a proper grade for further treatment, 50 per cent. of copper being a common figure ; (4) the percentage of sulphur, arsenic, and antimony volatilized in the blast furnace, from 8 per cent. in ordi-

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## REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

**The Cyanide Process.** By R. P. ROTHWELL. *Eng. Min. J.*, 62, 386.—In this country the cyanide process was first successfully carried out at the Mercer Mine, Camp Floyd district, Utah. The gold occurs there in limestone, and a high extraction is readily obtained with coarse ore. Usually ore has to be crushed through a 40-mesh screen, with the result that fully 50 per cent. of it can then be passed through a 100-mesh sieve, and such fine ore leaches slowly. If the pulp shows, in panning, particles of gold as coarse as the mesh-aperture, an exposure of a week to the solvent action of potassium cyanide has been found necessary to effect a satisfactory extraction. The ore best suited for cyaniding is one that is neutral or slightly alkaline and free from or very low in copper. Leaching telluride ores raw has not been satisfactory, the results varying greatly without any apparent cause. The reason is probably to be found in the different behavior of the tellurium minerals, sylvanite, petzite, calaverite, and hessite, with potassium cyanide. At present tellurides are roasted before leaching; roasting can be carried on without an appreciable loss of gold by volatilization, but the gold is liable to be left in the form of smooth globules not readily attacked by cyanide; furthermore, the ore must be dead-roasted, as neutralizing the ore with a wash of caustic soda has been found in many cases to reduce the extraction. In making laboratory experiments to serve as a basis for planning a mill, chemical tests ought to be supplemented by sizing-tests to show the subdivision of the gold in the pulp, and by microscopical examination to show the form in which it is present.

**Electrolytic Precipitation of Gold from Cyanide Solutions.**

By S. CROASDALE. *Eng. Min. J.*, 62, 57.—The paper is a record of a number of experiments carried out on a sufficiently large scale to allow the results to serve as a basis for industrial work. Amalgamated zinc, the most positive of the available metals, was used as the electro-positive, sheet lead as the electro-negative, pole. The current ranged from 0.04–0.05 amperes per square foot, the voltage was low, and the flow of solution such that the gold from half a pound of solution was deposited in 30 seconds on each square foot of depositing surface. A standard solution with 12.787 milligrams gold per liter gave up 98.04 per cent. of the gold; with a dilute solution of 1.84 grams gold per liter, the capacity had to be doubled to obtain an extraction of 93.48 per cent., the loss of cyanide from the 0.65 per cent. solution was only 2.845 per cent., and the solution from the precipitating vat was very active in dissolving gold. In using lead anodes as well as cathodes, the current had to be raised from 0.04 to 0.2 ampere per square foot, when much gas was set free and the solution, as it came from precipitating vat, was inactive though it became active after standing. The recovery of gold was 94.34 per cent., and the loss in cyanide 5.15 per cent.

**A New Gold-Saving Process.** By P. LANGHAMMER. *Min. Sci. Press*, 73, 316.—The innovation consists in drying, sizing, and stirring the ore, which is said to detach the films of gold and make them amenable to the solvent, potassium cyanide, which is to be applied separately to each size.

**The Value of the Pyrometer in the Down Comer.** By E. A. UEHLING. *Am. Manufacturer and Iron World*, 60, 115–117.—The writer calls attention to the importance of measuring in an iron blast furnace not only the temperature of the blast, but also that of the gas passing off through the down comer, which corresponds to from 5 to 8 tons for every ton of pig made and carries with it from 40 to 75 per cent. of the total heat energy contained in the fuel. Two temperature charts autographically recorded by the Uehling and Steinbart pneumatic pyrometer are given, each showing the temperatures of blast and of gas. One record represents the furnace in good condition, making 146 gross tons of good foundry iron with 147 gross tons of coke, the blast temperature ranging from 1000° to 1100° F. (average 1050°), and the gas temperature from 300° to 500° F. (average 400°); the other, when working unsatisfactorily, viz., 129.5 gross tons of iron of inferior quality, with 171 gross tons of coke, blast temperature 1000°–1200° F., gas temperature 700°–800° F. By calculation the author finds that in the case given 50 per cent. more gas was evolved with the higher than with the lower tem-

perature, which corresponds to 730 and 296 pounds of carbon per ton of iron made.

## INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

**Action of Water of the Hubb Coal Mine upon Cast Iron.** By FRANK W. DURKEE. *Am. Chem. J.*, 18, 849-858.—The author has examined samples of cast iron which had lain twenty-three years under water in the Hubb Coal Mine in Cape Breton, Nova Scotia, and has found that, while retaining its shape, it had materially altered in properties. The pieces were soft enough to be easily cut with a knife, and very brittle. A cross section showed an inner, softer part, lighter in color than the outer part. The transformed cast iron was magnetic, porous, and several times lighter than the same bulk of cast iron. Wrought iron which had been used in the mine was deeply corroded on the surface, but the interior was unaffected. The following figures, representing the average composition of the altered portion, were obtained by analysis:  $\text{SiO}_2$ , 12.25; Si, 1.67; C, 13.33;  $\text{H}_2\text{O}$  mechanically held, 3.53;  $\text{H}_2\text{O}$  combined, 5.21;  $\text{FeS}$ , 0.38;  $\text{SO}_4$ , 2.73;  $\text{P}_2\text{O}_5$ , 1.65;  $\text{CaO}$ , 1.25;  $\text{MgO}$ , 0.35;  $\text{MnO}$ , 0.30;  $\text{FeO}$ , 34.29; Fe as metallic iron and in the carbide  $\text{Fe}_3\text{C}$ , 23.06. Specific gravity, 2.5. The water in the mine was examined and found to contain in grams per liter: free and combined  $\text{H}_2\text{SO}_4$ , 0.4551; free  $\text{H}_2\text{SO}_4$ , 0.0230; Ca, 0.0419; Mg, 0.0222;  $\text{SiO}_2$ , 0.0153; Cl, 0.0284; As, 0.00005; Fe, Al, and Mg, 0.0096.

**Experiment with Gold.** By M. CAREY LEA. *Am. J. Sci.*, 153, 64.—On reducing some gold solutions with sodium hypophosphite the author noticed in special cases an emerald green color. This color is best produced by bringing together 15 cc. of a ten per cent. sodium hypophosphite solution, one cc. of gold chloride solution containing 0.10 gram of metallic gold and one drop of sulphuric acid. When the solution begins to darken 30 cc. of water are added. The solution now assumes a green transparent color, gradually becoming cloudy. If it is now filtered, it again becomes green and cloudy. This process can be repeated several times. The green color is due to a very small quantity of finely divided bluish-black metallic gold suspended in the yellow liquid.

**Silver Hydride.** By EDWIN J. BARTLETT AND WM. F. RICE. *Am. Chem. J.*, 19, 49-52.—Silver hydride,  $\text{AgH}$ , was prepared by precipitating a dilute solution of silver nitrate with dilute hypophosphorous acid in excess. The solution becomes wine-colored at first, changing to black, and after a few minutes

black, spongy flakes are precipitated, which are filtered at once. The filtrate, on long standing or boiling, deposits metallic silver. Silver hydride is not decomposed by water.

**Silicide of Chromium.** By G. DE CHALMOT. *Am. Chem. J.*, 19, 69-70.—Chromium silicide,  $\text{Si}_2\text{Cr}$ , was obtained by heating together in an electric furnace silica, charcoal, and chromium sesquioxide. It crystallizes in long, gray needles having a metallic luster; it is not attacked by cold hydrochloric acid or aqua regia, but dissolves in hydrofluoric acid. A sufficient quantity of pure crystals was not obtained for analysis, but the composition was determined in two specimens, to which some free silicon adhered. The specific gravity is 4.393.

**Action of Ferric Chloride on Metallic Gold.** By PARKER C. McILHINEY. *Am. J. Sci.*, 152, 293-294.—The author, in testing the solubility of metallic gold, found that it is not soluble in concentrated hydrochloric acid when heated in a pressure tube at  $150^\circ \text{ C}$ , nor in ferric chloride in absence of oxygen; but in presence of oxygen ferric chloride acts as a chlorine carrier, and dissolves appreciable quantities of gold.

**Silicides of Copper and Iron.** By G. DE CHALMOT. *Am. Chem. J.*, 19, 118-123.—In a former article (*This Rev.*, 2, 7) the author described a copper silicide of the formula  $\text{Cu}_2\text{Si}$ . Vigoureux has already made it appear improbable that any other copper silicide than  $\text{Cu}_2\text{Si}$  exists. The author has repeated his work, and concludes that while some crystals analyzed by him seem to have the composition represented by the formula  $\text{Cu}_2\text{Si}$ , there are present in these crystals both free silicon and free copper, and that the silicide present has in reality the formula  $\text{Cu}_2\text{Si}_1$ . This is, the author thinks, a case of chemical equilibrium between copper silicide and its decomposition products, copper and silicon. Contrary to the statement of Vigoureux, it is shown that copper silicon alloys containing up to 20 per cent. of silicon do contain free silicon. The author has established the existence of an iron silicide having the composition represented by the formula  $\text{FeSi}_1$ . By treating an iron silicon alloy containing about 39 per cent. of silicon with cold hydrofluoric acid, to which water was added, from time to time, there was left a residue of gray metallic crystals, which had the composition  $\text{FeSi}_1$ . The silicide is completely soluble in cold hydrofluoric acid, especially if the acid is concentrated, but is less soluble than the iron silicides containing less silicon.

**Drying and Deliquescence of Certain Salts.** By F. W. SMITHER. *Am. Chem. J.*, 19, 227-232.—Definite quantities of lithium, calcium, and magnesium chlorides, and of calcium and

magnesium nitrates were mixed with powdered glass and dried at a temperature of 97°–98° C. during six hours a day for thirty days, weighings being made daily. Each portion was dried in a desiccator over night, and in some cases moisture was absorbed from the calcium chloride of the desiccator, so that comparable results were not obtained; furthermore the magnesium salts lost acid after heating for some days. To test the absorption of water by the same salts dried quantities were placed in beakers together with a piece of lampwick, which helped to expose the salt to a greater surface. The beakers were placed in a bell-jar containing water and were weighed almost daily for seven weeks and thereafter weekly for five weeks. The results are tabulated together with calculations of the number of molecules of water absorbed, from which it appears that no definite degree of hydration took place.

**Metal Separations by Means of Hydrochloric Acid Gas.** By G. BIRD MOYER. *J. Am. Chem. Soc.*, 18, 1029–1044.—The author has converted the oxides of antimony, bismuth, copper and lead quantitatively into chlorides by heating them in a current of hydrochloric acid gas. With ferric oxide some reduction took place. By the volatility of the chlorides of bismuth and antimony he has separated them from copper and lead, and by the volatility of arsenic trichloride he has separated the arsenic from the arsenates of silver, copper, cadmium, cobalt and nickel. The mineral niccolite, dissolved in nitric acid and evaporated to dryness, is readily freed from arsenic by this method.

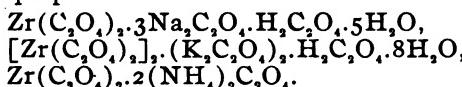
**The Action of Acid Vapors on Metallic Sulphides.** By JEROME KELLEY, JR. AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, 18, 1096–1098.—Arsenic, antimony, and stannic sulphides are converted into the chlorides by heating in a current of hydrochloric acid gas; stannous sulphide is also converted into the chloride, but cannot be volatilized. The dry sulphides of arsenic and antimony are completely volatilized when exposed to hydrobromic acid gas.

**Tungsten Hexabromide.** By HERBERT A. SCHAEFFER AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, 18, 1098–1100.—Tungsten hexabromide, consisting of blue black crystals, was prepared by heating tungsten in a current of bromine diluted with nitrogen. It fumes in the air, and is decomposed by water into a blue oxide.

**Note on the Ferrocyanides of Zinc and Manganese.** By EDMUND H. MILLER. *J. Am. Chem. Soc.*, 18, 1100–1102.—This paper is a preliminary note relating to the composition of these salts.

**Analysis of an Iron Rail Taken from a Gallery of an Unused Coal Mine.** By HENRY P. TALBOT AND A. G. WOODMAN. *J. Am. Chem. Soc.*, 19, 9-12.—This article gives the results of the analysis of a cast iron rail which had lain twenty-three years under water in the Hub Mine, at Glace Bay, Cape Breton. It was composed of an inner and outer portion, the densities of which seemed to increase with length of exposure to the air. The results are compared with those of Herting (*Chem. Ztg.*, 20, 54), who analyzed a similar rail. (See also above, this *Rev.*, 3, 51.)

**The Oxalates of Zirconium.** By F. P. VENABLE AND CHARLES BASKERVILLE. *J. Am. Chem. Soc.*, 19, 12-18.—Basic oxalates of zirconium were formed by precipitation. It was found impossible to obtain the neutral oxalate. The acid oxalate  $Zr(C_2O_4)_2 \cdot H_2C_2O_4 \cdot 8H_2O$ , and the following double oxalates were prepared:



**Preparation of Sodium Nitroprusside.** By F. S. HYDE. *J. Am. Chem. Soc.*, 19, 23-24.—Detailed directions for the preparation of pure sodium nitroprusside are given in this paper.

**Some Peculiar Forms of Iron.** By T. H. NORTON. *J. Am. Chem. Soc.*, 19, 108-110.—A mass of pig iron which had been in the molten condition for over a year was analyzed and found to be practically pure iron, except for a high percentage of phosphorus—0.828. It was extremely hard, malleable, and crystalline, showing rectangular cleavage.—The support for the mantle of a Welsbach burner was found to be extremely brittle, crumbling easily. Analysis showed 0.097 per cent. carbon, while the original steel contained 0.642 per cent.

**A Tungsten-Iron Alloy.** By T. H. NORTON. *J. Am. Chem. Soc.*, 19, 110.—Analysis of a hard and brittle tungsten-iron alloy of specific gravity 14.55, showed 93.43 per cent. tungsten and 6.18 per cent. iron.

**Our Present Knowledge of Argon.** By C. LEROY PARKER. *J. Am. Chem. Soc.*, 19, 124-138.—This paper contains nothing original, but is a review of our knowledge of argon, to which is added a valuable bibliography.

**On the Volatility of Certain Inorganic Salts.** By T. H. NORTON AND D. M. ROTH. *J. Am. Chem. Soc.*, 19, 155-166.—The authors have examined the volatility of borax, of sodium and potassium fluorides, and of barium chloride. The results are tabulated and compared with the time it takes to volatilize

0.01 gram sodium chloride in the hottest part of the Bunsen flame.

H. P. TALBOT, REVIEWER.

**On the Volatility of Ferric Chloride.** By HENRY P. TALBOT. *Am. Chem. J.*, 19, 52-59.—The experimental data show that no loss of ferric chloride occurs, when its solutions (whether neutral or acidified with hydrochloric acid) are evaporated to dryness on the water-bath or upon the hot plate, provided in the latter case they are not too strongly overheated. The residues so obtained were subjected to the temperature usually employed to dehydrate silicic acid ( $130^{\circ}$  C.) for two hours, but suffered no loss of iron. Prolonged heating of these residues over a free flame occasioned but a slight loss (0.4 per cent.) of the iron present. Concentrated acid solutions of the chloride, when boiled in a distilling flask, allowed ferric chloride to pass into the receiver only when a slight separation of the solid had taken place on the side of the flask, which, in the acid atmosphere, was volatilized by the overheating of the glass. When ferric chloride solutions are evaporated with exposure to the air, a loss of chlorine ensues, and the basic ferric salt formed prevents loss of the iron as chloride. The presence of ammonium chloride with the ferric chloride occasioned no loss of the latter, even at  $130^{\circ}$  C. The residues, when heated over a free flame, suffered a loss of iron, as would be expected. The presence of aqua regia with the ferric chloride solution tends to occasion a slight loss of iron during evaporation. The maximum loss was 0.6 per cent. of the iron present, but in other cases very little or no loss could be detected. Vogel's experiments (*N. Rep. Pharm.*, 18, 157) were repeated, and it was found that a slight volatilization of iron seems to take place from an ethereal solution at the temperatures of the laboratory, but, on the other hand, the presence of ether or its vapor does not promote the volatilization of the ferric chloride from its boiling, concentrated, aqueous solutions.

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## ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

**Investigations on the Two Isomeric Chlorides of Orthosulphobenzoic Acid.** By IRA REMSEN. IV. Purification of the Chlorides and Action of Various Reagents upon Them. By IRA REMSEN AND S. R. MCKEE. V. The Relation of the Anilides. By IRA REMSEN AND J. R. HUNTER. VI. Orthocyanbenzenesulphonic Acid. By IRA REMSEN AND W. J. KARSLAKE. *Am. Chem. J.*, 18, 791-829.—In earlier articles (*Am. Chem. J.*, 17, 309-347; *Tech. Quart.*, 8, 194) the preparation

and properties of the two isomeric chlorides of orthosulphobenzoic acid were described, and evidence was presented which shows that the chloride melting at 79-79°.5 has the structure  $C_6H_4\begin{array}{l} COCl \\ \swarrow SO_2Cl \end{array}$ . The reactions of the carefully purified chlorides with various reagents and the resulting compounds have been studied, and additional evidence in favor of the unsymmetrical structure for the low-melting chloride furnished. (IV.) To obtain the high melting chloride in pure condition, an ethereal solution of the mixed chlorides is evaporated to crystallization, after being shaken with dilute ammonia, which transforms the low-melting chloride into the ammonium salt of cyanbenzenesulphonic acid. The pure low-melting chloride (m. pt. 21°.5-22°.5) is obtained by fractional crystallization at 0° of the mixed chlorides from carefully purified ligroin boiling at 90°-125°. Water decomposes the low-melting chloride about three times as fast as the high-melting chloride. 65 per cent. of the former was changed to acid after standing four days at the ordinary temperature. Both chlorides give the same products when heated with phenol; *viz.*, the diphenyl ester of orthosulphobenzoic acid and a compound, probably of the structure  $C_6H_4\begin{array}{l} COOC_6H_5 \\ \swarrow SO_2Cl \end{array}$ , which is changed by dilute ammonia into phenylorthosulphaminebenzoate,  $C_6H_4\begin{array}{l} COOC_6H_5 \\ \swarrow SO_2NH_2 \end{array}$ . The diphenyl ester was saponified when heated at 200°, with concentrated hydrochloric acid, and was transformed into the ammonium salt of benzoic sulphinide,  $C_6H_4\begin{array}{l} CO \\ \swarrow SO_2 \end{array}>N.NH_4$ , when heated at 125° for four hours with ammonia. With resorcinol both chlorides gave the same sulphonfluorescein. When the high-melting chloride was treated with aniline, only the fusible anilide,  $C_6H_4\begin{array}{l} SO_2NHC_6H_5 \\ \swarrow CONHC_6H_5 \end{array}$ , (m. pt. 194°-195°) was obtained. The low-melting chloride yielded a mixture of equal amounts of the above compound and the infusible anilide,  $C_6H_4\begin{array}{l} C(NHC_6H_5)_2 \\ \swarrow SO_2 \end{array}>O$ , which melts at 250°-270° with decomposition. With ammonia the high-melting chloride gives the ammonium salt of benzoic sulphinide, while the low-melting chloride gives the ammonium salt of orthocyanbenzenesulphonic acid. The latter transformation is additional evidence in favor of the unsymmetrical structure for the low-melting chloride,  $C_6H_4\begin{array}{l} CCl_3 \\ \swarrow SO_2 \end{array}>O$ . When the

latter compound was dissolved in ether and shaken with dilute ammonia, it was in part, changed into the high-melting chloride. By the action of benzene and aluminum chloride on the low-melting chloride the same compounds were formed which had been obtained by Remsen and Saunders (*loc. cit.*) from the high-melting chloride; namely, orthobenzoylbenzenesulphonchloride and orthobenzoyldiphenylsulphone. It was impossible to change the low-melting chloride into its isomer by heating in a sealed tube at 90°, or by shaking with water for half an hour. (V.) The two anilides of orthosulphobenzoic acid were prepared by the action of an ethereal solution of aniline on the mixed chlorides. By crystallization from alcohol the two isomers can be separated, as the fusible anilide crystallizes in thin white needles, while the infusible variety crystallizes in short thick prisms. Phosphorus oxychloride and phosphorus pentoxide removed one molecule of water from both compounds

forming the dianil,  $C_6H_4\begin{array}{c} C=NC_6H_5 \\ \diagup \\ SO_2 \\ \diagdown \end{array}>NC_6H_5$ , which had already been obtained by Jesurin (*Ber. d. chem. Ges.*, 26, 2292) by the action of aniline on orthocyanbenzenesulphonchloride. The compound crystallizes in yellow monoclinic prisms, is changed by boiling acetic acid or alcoholic potash into the infusible anilide, and is decomposed into the anil  $C_6H_4SO_2CO.NC_6H_5$  and aniline by boiling hydrochloric acid. The infusible anilide reacts with benzoyl chloride, forming the anil and benzamilide. Since the above facts show that the two aniline residues are intact in the infusible anilide, and since the latter compound is obtained only from the unsymmetrical chloride, it follows that the structure of the

anilide is  $C_6H_4\begin{array}{c} C=(NHC_6H_5)_2 \\ \diagup \\ SO_2 \\ \diagdown \end{array}>O$ . (VI.) The mixed chlorides of orthosulphobenzoic acid were dissolved in ether and shaken with ice-cold dilute ammonia. From the water solution the ammonium salt of orthocyanbenzenesulphonic acid crystallized in botryoidal masses of transparent needles. The sodium, potassium, and barium salts were prepared, and from the latter orthobenzaminesulphonic acid,  $C_6H_4\begin{array}{c} CONH \\ \diagup \\ SO_2OH \\ \diagdown \end{array} + H_2O$ , was ob-

tained in an endeavor to get the free cyan acid,  $C_6H_4CN.SO_2OH$ . The ammonium salt of the former acid was obtained by boiling the ammonium salt of the latter with dilute hydrochloric acid for eight hours. The potassium, sodium, and barium salts of benzaminesulphonic acid were formed by boiling the ammonium salt of cyanbenzenesulphonic acid with an excess of the respective hydroxides.

**On Parabromdimetanitrotoluol and Some of Its Derivatives.**

By C. LORING JACKSON AND MARTIN H. ITTNER. *Am. Chem. J.*, 19, 1-37.—The work described was undertaken in order to find out whether a bromine atom in the ortho position between two nitro groups, but not exposed to the loosening action of a third negative group in the para position, could be removed easily, and be replaced by a hydrogen atom under the influence of sodium malonic ester, as has been frequently observed by Jackson and his pupils in the study of more highly substituted aromatic compounds. The compound selected for investigation, parabromdimetanitrotoluene, proved to be not very reactive; but this was probably due to the influence of the methyl group. It was prepared from dinitrotoluidine, melting at 166°, and was converted by warm aniline into anilidodinitrotoluene (m. pt. 169°), which gave a nitroso derivative, which melts at 123°. Although sodium malonic ester did not act upon bromdinitrotoluene under a variety of conditions, sodium ethylate gave striking color reactions, which are to be described in another paper. The bromine was not replaced, as no dinitrotoluene was found. With ammonia, bromdinitrotoluene gives dinitrotoluidine, and with sodium hydroxide, dinitro cresol. Parabromdimetanitrobenzoic acid was made by oxidizing the corresponding toluene. It melts at 181°, and is more reactive than parabromdinitrotoluene, since the bromine atom is affected by the carboxyl group in the para position. Sodium hydroxide in the cold converts it into oxydinitrobenzoic acid (m. pt. 245°-246°). Bromdinitrobenzoic acid gives, with ammonium hydroxide, chrysanic acid; with aniline, anilidodinitrobenzoic acid; and with sodium, malonic ester, at ordinary temperatures, dinitrocarboxylphenylmalonic ester,  $C_6H_5CH(COOC_2H_5)_2(NH_2)_2COOH$  (m. pt. 176°.) A number of the salts and the ethyl esters of the acids were prepared. An attempt was made to build up very complex molecules from some of the substances described, in order to study the effect of complexity of structure on physical properties. The resulting compounds soon ceased to be crystalline, and the work was therefore abandoned. By the action of pyridine on bromdinitrobenzoic acid two compounds were obtained: a white body, probably a simple salt of the acid; and a very unstable yellow compound whose reactions pointed to the structure,  $C_6H_5NBrC_6H_4(NO_2)COOHNC_6H_5$ . Some preliminary work on the action of hydrochloric acid on bromdinitrobenzoic acid showed that the products were dinitrophenol ( $OH, 1, (NO_2), 2, 6$ ) and oxydinitrobenzoic acid.

**Aluminum Ethylate.** By H. W. HILLYER AND O. E. CROOKER. *Am. Chem. J.*, 19, 37-44.—In a previous paper (*Am. Chem. J.*, 18, 621; *this Rev.*, 2, 80), Hillyer has shown

that aluminum reacts with alcohol in which mercuric or stannic chloride is dissolved, liberating hydrogen and forming a gelatinous mass. During the reaction the metallic chlorides are reduced. The reaction has been studied further; and the authors are of the opinion that it is due to the joint influence of the aluminum-mercury couple and the aluminum chloride formed in the reduction of the mercuric chloride. The product of the reaction when distilled under a pressure of 23 mm. boiled at  $235^{\circ}$ - $245^{\circ}$ , and solidified to a gummy mass which melted at  $135^{\circ}$ . A mixture of one cc. of stannic chloride, 5 grams of chipped aluminum, and 50 cc. of absolute alcohol gives the best results. The authors consider that the chlorine found in the distillate, even after a number of distillations, shows the presence of aluminum chloride. The compound was analyzed for chlorine and aluminum, and, deducting the amount of the latter equivalent to the chlorine, the analyses give results closely approximating those required for aluminum ethylate,  $\text{Al}(\text{OC}_2\text{H}_5)_3$ . The properties of the compound agree with those of the ethylate prepared by Gladstone and Tribe (*J. Chem. Soc.*, 39, 1) by the action of aluminum and iodine on alcohol.

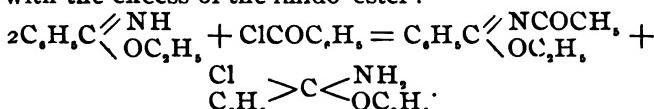
**Paraisobutylphenoxyacetic Acid.** By W. P. BRADLEY AND F. KNIFFEN. *Am. Chem. J.*, 19, 70-76. — Paraisobutylphenoxyacetic acid was prepared by heating paraisobutylphenol and chloracetic acid dissolved in sodium hydroxide. The mixture was neutralized with sulphuric acid, treated with an excess of sodium carbonate, and extracted with ether to remove any excess of phenol. The resulting liquid was then evaporated to a small bulk, acidified, and the acid extracted with ether. The compound is a cream white solid, melts at  $86^{\circ}.5$ , and crystallizes from ligroin in radial crystals. The barium and magnesium salts crystallize well. The amide, prepared from the methyl ester, crystallizes from ligroin in white plates, which melt at  $134^{\circ}$ . The anilide, metanitranilide, ortho- and paratoluides, and hydrazide are described. A tetranitro derivative of the anilide was formed by the action of fuming nitric acid. The fact that the four nitro groups are divided equally between the two benzene rings was proved by the action of potassium hydroxide, which decomposed the compound into the ortho- and paradinitraniline.

**Formation of Diacetylenyl (Butadiine) from Copper Acetylene.** By A. A. NOYES AND C. W. TUCKER. *Am. Chem. J.*, 19, 123-129.—The object of the investigation was to establish the constitution and to explain the formation of the crystalline compound of the formula  $\text{C}_4\text{H}_2\text{Br}_2$ , obtained by Sebanejeff, (*Ber. d. Chem. Ges.*, 22c, 249) by passing acetylene, from copper acetylene, into boiling bromine. The attempts to prepare the body

by the action, upon boiling bromine, of acetylene generated from calcium carbide, were unsuccessful. The gas obtained by the action of hydrochloric acid on the copper compound prepared from acetylene generated from calcium carbide was passed into boiling bromine. A 4 per cent. yield of crystals, identical in properties with those of Sebanejeff, was obtained. Substitution of potassium cyanide for hydrochloric acid, and varying the condition of combination of the gas with bromine did not affect the result. As the addition of strips of metallic copper to the copper acetylene during decomposition prevented the formation of the compound, it seemed probable that its formation was due to the oxidizing action of the cupric chloride formed by the contact of the decomposing mixture with the air. Copper acetylene was decomposed in the presence of cupric chloride, and the yield was increased to 9 per cent. When molecular quantities of copper acetylene and cupric chloride were heated for 3 hours, the latter was entirely reduced. Analyses and molecular weight determinations of the bromide showed that its formula is  $C_4H_6Br_2$ . It melts at  $183^{\circ}.5$  (corr.), crystallizes in colorless orthorhombic plates, evolves bromine when heated above its melting-point, and furnishes a distillate, which partially recombines with the bromine vapors, when heated at  $220^{\circ}$  under a pressure of 40 mm. That the body is not a derivative of the hydrocarbon ( $CH_4$ ), is shown by the facts, that it is obtained from the oxidation-products of acetylene or its copper compound, and that the gas evolved from copper acetylene is completely absorbed by ammoniacal cuprous chloride, thus showing it to consist only of triple-bonded compounds. The only explanation is that the bromide is formed by the union with bromine of the hydrocarbon  $C_4H_6$ , diacetylenyl or butadiene, obtained from its copper compound, which is formed according to the reaction  $2C_2H_2 + CuCl_2 = C_4H_6 + 2CuCl$ . That the hydrocarbon combines with only six atoms of bromine is explained by the principle that unsaturated compounds containing a large proportion of halogen often do not become completely saturated. From the gases evolved from copper acetylene a liquid was condensed, which boiled at  $40^{\circ}$  to  $50^{\circ}$  and gave with bromine diacetylenyl hexabromide. The crude product was not the pure hydrocarbon, for it contained a large proportion of chlorine.

**On the Action of Acid Chlorides on the Imido Esters and Isoanilides, and on the Structure of the Silver Salts of the Anilides.** By H. L. WHEELER AND P. T. WALDEN. *Am. Chem. J.*, 19, 129-139.—As the silver salts of the anilides react with acid chlorides as if the metal were joined to nitrogen, and with alkyl halides as if the metal were joined to oxygen, it fol-

lows that both reactions cannot be direct double decompositions. It seems probable that addition first takes place, and that this is followed by separation of silver halide. In order to show which of the two possible structures of the silver salts of the anilides  $\text{RC}\diagup\text{NR}'\text{Ag}$  or  $\text{RC}\diagup\text{NR}'\text{OAg}$  is correct, the action of acid chlorides was studied on the isoanilides and imido esters, which, it is probable, contain the grouping  $\text{RC}\diagup\text{NR}'\text{OR}''$ . With the iso-anilides an unstable addition-product is first formed, which breaks down with evolution of alkyl chloride and formation of a mixed diacid anilide. As the reaction takes place readily and is analogous to that between the acid chlorides and the silver salts of the anilides, it follows that the metal is joined to oxygen in the latter compounds. This is in accord with the conclusion of Comstock and Kleeburg (*Am. Chem. J.*, 12, 495). Acid chlorides react with imido esters forming an addition-product from which hydrochloric acid is eliminated. The acid reacts with the excess of the imido ester :



When the acyl imido esters are treated with acids they react with water to form diacid amides and alcohol. The decomposition is analogous to the action of the silver salts of the amides and anilides with acids, and is evidence, therefore, that the diacid amides have both acid groups joined to nitrogen. The action of bromine and iodine on the imido esters is similar to that of the acid chlorides. The new compounds described are formylbenzenesulphonanilide,  $\text{C}_6\text{H}_5\text{N}(\text{CHO})\text{SO}_3\text{C}_6\text{H}_5$ , benzoyl-imidoethylbenzoate,  $\text{C}_6\text{H}_5\text{C}(\text{NCOC}_6\text{H}_5)\text{OC}_6\text{H}_5$ , acetyl-imido-methylbenzoate, bromimidomethylbenzoate,  $\text{C}_6\text{H}_5\text{C}(\text{NBr})\text{OCH}_3$ , and iodimidomethylbenzoate.

**On the Effect of Light on the Displacement of Bromine and Iodine from Organic Bromides and Iodides.** By J. H. KASTLE AND W. A. BEATTY. *Am. Chem. J.*, 19, 139-149.—The authors have found that chlorine liberated from dichlorosulphonamide by the action of light can displace bromine and iodine from their most stable compounds, and that the bromine of dibromosulphonamide, when liberated, can displace iodine from the benzene ring. In the dark there is no liberation of chlorine from the amide and, consequently, no displacement of bromine or iodine from organic halides, except from unstable compounds like iodoform, where a direct reaction takes place. Chlorine water caused a similar decomposition. Experiments showed that up

to 50° the reaction is more dependent upon light than heat. At 14°-18° a mixture of dibrombenzene and chlorine water, after six hours exposure to direct sunlight, gave a good test for bromine, while a similar mixture, heated for five hours in the dark at 50°, suffered no change. Above 50° the reaction takes place in the dark. When *p*-dibrombenzene and chlorine water were exposed to the sunlight for a number of days, a large proportion of the bromine was liberated and a substance, probably a mixture of *p*-chlorbenzene and *p*-brombenzene or *p*-chlorbrombenzene, was formed.

**The Constitution of Benzanilide.** By N. KNIGHT. *Am. Chem. J.*, 19, 152-154.—If the formula of benzanilide is  $C_6H_5C\begin{cases} \diagup & \diagdown \\ NHC_6H_5 & O \end{cases}$ , the same product should result when benzenesulphanilide is treated with benzoyl chloride, or when benzanilide is treated with benzenesulphonchloride. If the formula is  $C_6H_5C\begin{cases} \diagup & \diagdown \\ OH & NC_6H_5 \end{cases}$ , the reaction-product should be different. The above reactions were studied, but, as in both cases there was a complete breaking down, and a number of substances were formed, no conclusion as to the structure could be drawn. The chief products of the reaction were dibenzoyl anilide and the aniline salt of benzenesulphonic acid.

**On the Decomposition of Diazo Compounds. IX. On the Reactions of Ethyl and Methyl Alcohols with Paradiazometatoluenesulphonic Acid in the Presence of Various Substances.** By JOHN J. GRIFFIN. *Am. Chem. J.*, 19, 163-183.—The work described in this communication, the ninth from the laboratory of the Johns Hopkins University on the subject of diazo compounds, is in accord with the results already published. It has been found that, when paradiazometatoluenesulphonic acid is decomposed below 45° in methyl or ethyl alcohol in the presence of sodium methylate, sodium carbonate, sodium hydroxide, or zinc dust, only the hydrogen reaction takes place. The yield of the resulting acid was determined by converting it into the amide. The best yield (50 grams amide from 100 grams diazo compound) was obtained by effecting the decomposition in ethyl alcohol in presence of zinc dust, treating the resulting mass with phosphorus trichloride and then with ammonia. It is remarkable that the product obtained by decomposing the diazo compound in presence of sodium carbonate did not react with phosphorus trichloride, but was changed into the sulphon-chloride by the pentachloride. The diazo compound was not decomposed when treated at 45° with alcohol and calcium carbonate. When decomposition takes place in alcohol saturated

with ammonia, the ammonium salt of paratoluidinemetasulphonic acid is formed. Metatoluene sulphonamide melts at 108°, and crystallizes from concentrated solutions in brilliant hexagonal scales and from dilute solutions in large fern-like growths. The amide was oxidized to metasulphaminebenzoic acid, from which the barium and silver salts were made.

**On Metatoluene Sulphonic Acid.** By JOHN J. GRIFFIN. *Am. Chem. J.*, 19, 183-198.—From a study of the literature of metatoluene sulphonic acid, a review of which is given by the author, it is evident that the properties of the acid and its salts are not definitely known. A large amount of pure metatoluene sulphonamide, which was obtained in the work described in the previous review, was converted into the acid, from which the barium, lead, calcium, sodium, potassium, silver, magnesium, manganese, zinc, and copper salts were prepared. These are described in detail. From the study of the acid and its salts it is evident that the compounds described by Müller (*Ann. Chem.*, 169, 47) and by others who have employed analogous methods of preparation were impure products.

**The Preparation of Diethyl Malonic Ester.** By W. A. NOVES. *J. Am. Chem. Soc.*, 18, 1105.—The time required for the preparation of malonic ester is much reduced by heating the reacting substance with sulphuric acid for an hour instead of treating with dry hydrochloric acid gas. The yield of the ester is equal to the weight of the chloracetic acid taken. This is 10 to 15 per cent. better than by the old method.

**Color Reactions of Nitric and Chloric Acids with Certain Aromatic Bodies.** By E. C. WOODRUFF. *J. Am. Chem. Soc.*, 19, 156-169.—The color reactions of nitric and chloric acids with a large number of aromatic compounds were studied, in order to find some new practical tests for the two acids both separately and in mixtures. The procedure was to treat the test solution, generally as a mixture of 10 grams of aromatic body and 100 cc. sulphuric acid, with a drop of a nitrate or a chlorate or a mixture of the two. After standing a short time, potassium hydroxide or ammonium hydroxide is added and the solution is diluted. The color is noted at three stages, before and after neutralization, and after dilution. The results with twenty hydroxyl and amido derivatives are tabulated. Phenol serves to distinguish between the two acids, as nitrates give a strong picrate-colored solution, while chlorates give a brownish-yellow color. Nitrates can be detected in the presence of chlorates, bromates, and iodates, as they give a strong blood-red color with a mixture of dimethylaniline, paratoluidine, and sulphuric acid. Reference must be made to the original article for a number of other interesting observations.

## GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

W. O. CROSBY, REVIEWER.

**Italian Petrological Sketches, II. The Viterbo Region.** By HENRY S. WASHINGTON. *J. Geol.*, 4, 826-849.—Lavas of two distinct types, obtained from the Viterbo region, which lies a few kilometers southeast of the volcanic district of Lake Bolsena, are described, the trachytic lavas under the names vulsinite, ciminite and peperino, and leucitic lavas, under the name of leucite-trachyte. One original analysis of ciminite is given, and three earlier ones are quoted for comparison. These show that while as regards the silica, alumina, lime or iron the rock approaches the andesites rather than the trachytes, yet that the potash is largely in excess of the soda, and that the rock is far richer in total alkalies than is the case with the true andesites. On the other hand, the magnesia is also abnormally high for a trachyte. Analyses are also given of the vulsinite, leucite-trachyte, and a phonolite, which occurs very sparingly, as dikes and enclosed masses.

**Italian Petrological Sketches, III. The Bracciano, Cerveteri and Tolfa Regions.** By HENRY S. WASHINGTON. *J. Geol.*, 5, 34-49.—As in the Viterbo region, the rocks embrace both non-leucitic and leucitic types; but these are regarded as specifically distinct from the Viterbo rocks, and are described, the former under the name toscanite, and the latter under the names leucite, leucite-tephrite, and leucite-phonolite. Original analyses of all these are given in tabular form; and the distinctive chemical features are briefly indicated.

**The Principles of Rock Weathering.** By GEORGE P. MERRILL. *J. Geol.*, 4, 704-724; 850-871.—This is an able and comprehensive summary of our knowledge of the subject, and must prove of great value to students. Both the chemical and physical aspects of the problem are discussed; and no more important results are presented than those derived from the author's earlier contribution to the literature of rock decay.

**The Anorthosites of the Rainy Lake Region.** By A. P. COLEMAN. *J. Geol.*, 4, 907-911.—In the vicinity of Rainy and Bad Vermilion Lakes very basic and very acid igneous rocks—anorthosites and quartzose granites—are found associated. One analysis of each is given, and an analysis of anorthosite from Quebec is quoted for comparison. It appears that the anorthosite from the Rainy Lake region is one of the most basic of the massive rocks, having about eight per cent. less silica than the typical anorthosites of Eastern Canada. A suggestion for a binomial nomenclature of these rocks is followed by a brief discussion of their age and petrologic relations.

**The "Augen"-Gneiss Area, Pegmatite Veins and Diorite Dikes at Bedford, N. Y.** By LEA McL. LUQUER AND HEINRICH RIES. *Am. Geol.*, 18, 239-261.—Two analyses of the feldspar in the pegmatite veins show that it is a normal orthoclase.

**A New and Important Source of Phosphate Rock in Tennessee.** By JAMES M. SAFFORD. *Am. Geol.*, 18, 261-264.—The Trenton limestone of the region about Nashville, and especially the member of it known as the Capitol limestone, is normally more or less phosphatic, the richer parts showing upon analysis from 15 to 25 per cent. of phosphate. The true phosphate rock is a residuum after the leaching by meteoric waters of the phosphatic limestone. It is found immediately beneath the soil in layers from three to eight feet thick, and is in every respect of a distinctly residuary character. An analysis by J. M. McCandless, of Atlanta, gave: Calcium phosphate (bone phosphate), 77.54; iron and alumina, 1.50; calcium carbonate, 6.83. Other analyses made in Nashville show the calcium phosphate to range from 60 to 81 per cent.

**The Arlington Iron, Minnesota No. 2.** By N. H. WINCHELL. *Am. Geol.*, 18, 267-271.—This iron, weighing 19 $\frac{1}{4}$  pounds, was found two and a half miles northeast of Arlington, Minn., in March, 1894. It proved on examination to be a typical metallic meteorite, and an analysis by F. F. Sharpless, gave the following results: Fe, 90.781; Ni, 8.605; Co, 1.023; P, 0.045; total, 100.454. It yielded no sulphur, silicon, or manganese, and only traces of chromium, copper and combined carbon.

**Missourite, a New Leucite Rock from the Highwood Mountains of Montana.** By WALTER H. WEED AND LOUIS V. PIRSSON. *Am. J. Sci.* 152, 315-323.—The Highwood Mountains form an isolated group consisting of extinct, greatly eroded volcanoes. Forming the core of one of these denuded volcanoes is a granular rock of a new type and of exceptionally interesting petrologic character to which the authors have given the name Missourite. The microscope shows the following minerals: apatite, iron ore, olivine, augite, biotite, leucite, and some zeolitic products. As the presence of leucite in a granular plutonic rock was before unknown, particular pains were taken to place its identification beyond doubt. It was isolated by means of a heavy solution, and found to have the specific gravity, optical characters, and composition  $KAl(SiO_4)_2$  of leucite. With one exception, this is the first analysis of a leucite from other than an Italian locality. The zeolitic products were similarly isolated and analyzed, and proved to be analcime and a natrolite in which potash and lime have replaced soda. A mass analysis of

the rock by E. B. Hurlburt is also given. This brings out strongly the leading characteristics of the rock, its very high lime, iron, and magnesia, which have compelled the formation of large quantities of pyroxene and olivine; the predominance of potash over soda, which with the low silica have conditioned the formation of the leucite, and which explains why no feldspars have formed. The mineralogical composition is believed to be: iron ore, 5; augite, 50; olivine, 15; biotite, 6; leucite, 16; analcite, 4; and zeolites, 4 per cent. Analyses of absarokite, shonkinite, and a leucite basalt are quoted for comparison; and it is shown that this rock fills a place which has hitherto been vacant in all systems of rock classification. It is the massive, granular, plutonic representative of the leucite basalts and bears the same relation to them that gabbro bears to the ordinary plagioclase basalts or granite to rhyolite.

**Chemical Composition of Hawaiian Soils and of the Rocks from Which They Have Been Derived.** By A. B. LYONS. *Am. J. Sci.*, 152, 421-429.—The author states that the relation in chemical composition of soils to the rocks from which they are definitely derived, can be studied most easily and profitably in a volcanic country, where disintegration of the rock is rapid and is attended by great chemical changes. The chemical composition of these volcanic soils is peculiarly interesting and full of surprises to one unaccustomed to their vagaries. Ten original analyses of the soils are given, classified as follows: New soils from lapilli (recent fragmental lava); new soils from lava only partially disintegrated; old soils from thoroughly disintegrated ancient lava. The new soils are of a sandy character, containing but little clay; and yet the mineral constituents requisite for plant food—potash and phosphoric acid—are present in extraordinary abundance. Two of the lapilli soils are almost incredibly rich in phosphate, containing respectively 2.92 and 6.47 per cent. P<sub>2</sub>O<sub>5</sub>. The old soils are clayey, of a deep red color, and relatively poor in phosphate, though comparing very favorably in potash with the new soils. The lavas are highly basic rocks, the more recent forms running as low in silica as 35.86 per cent., the average of the nine analyses given being 47.86 per cent. The ultra-basic recent lavas, especially, are rapidly decomposed by acids with separation of gelatinous silica and evolution of hydrogen sulphide. The variations are 0.17 to 2.75 per cent. K<sub>2</sub>O, and 0.26 to 1.25 per cent. P<sub>2</sub>O<sub>5</sub>; the averages are 1.07 per cent. K<sub>2</sub>O and 0.65 per cent. P<sub>2</sub>O<sub>5</sub>. A third table of analyses gives the composition of lavas altered by exposure to the weather. There has been a notable loss of silica, the average being reduced to 21.32 per cent., with a minimum of 4.54 per cent.; while the alkalies and alkaline earths have almost wholly

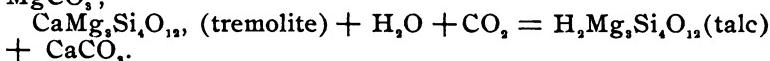
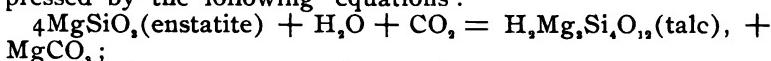
disappeared. A fourth table compares the averages of all the analyses of sound lava, rotten lava, and soil.

**Some Queries on Rock Differentiation.** By GEO. F. BECKER.  
*Am. J. Sci.*, 153, 21-40.—This paper is an able and timely criticism of the general theory of magmatic differentiation, and especially of the attractive phase of this theory that was first distinctly formulated by Iddings, which regards molten magmas as complex solutions, and hence, in accordance with Soret's principle, subject to differentiation by molecular diffusion when the temperature is not uniform. The author does not deny that diffusion plays some part in lithogenesis, recognizing its operation in the formation of phenocrysts and in the "diffusion aureoles" surrounding eroded crystals. But his criticism is aimed at the view that masses of rock hundreds of meters in thickness could be thus separated, even if the time allowed for completion of the process were equal to an entire geological period. The results of experiments are cited to show that even under the most favorable conditions molecular diffusion is an exceedingly slow process. For example, it is calculated that at the expiration of a million years water would be just sensibly discolored by copper sulphate at a distance of 350 meters from the point of contact with a saturated solution and that semi-saturation would have reached only a distance of some 84 meters. It is assumed that for a typical lava these periods would be at least 50 times greater. Probably a mass of lava of a volume of one cubic kilometer would not have had time to segregate into distinctly different rocks by molecular flow if it had been kept melted since the close of the Archaean, even if the temperature of the top could have been kept sensibly above the temperature of the bottom, a highly improbable condition. If the bottom were more highly heated than the top, convection currents would effectually prevent any segregation in accordance with Soret's principle. Convection is regarded as inevitable in every instance and as constantly and completely neutralizing any possible effect of diffusion. The author next examines the theory that rock differentiation is due to the separation of the magmas during cooling into two or more immiscible fluids, citing the experiments of Alexejew, Pfeiffer, Sorby, Braun, and others. The conclusion reached is that while such a breaking up of magmas probably occurs under favorable conditions, no known causes are adequate to the segregation of the immiscible fluids. The author thus virtually abandons the whole theory of rock differentiation, and for an explanation of the great diversity of igneous rocks falls back upon the view that the differences between well-defined rock types are due to original and persistent heterogeneity in the composition of the globe.

**On Igneous Rocks from Smyrna and Pergamon.** BY HENRY S. WASHINGTON. *Am. J. Sci.*, 153, 41-50.—This paper contains detailed descriptions and chemical analyses of two rock types, augite-andesite and biotite-dacite.

**Notes on the Artesian Well Sunk at Key West, Florida, in 1895.** BY EDWARD OTIS HOVEY. *Bull. Museum Comp. Zool.*, 28, No. 3, 65-91.—In 1895 an artesian well was sunk at Key West, Florida, to the depth of 2,000 feet. Samples of the borings were taken every 25 feet from the surface to the bottom; and this paper embodies the results of a microscopic and chemical examination of these. The material is throughout an almost perfectly pure lime-rock, loosely compacted in the main, and varying from sandy to oölitic in texture, indicating a shallow water origin for a large part of it. Nearly all the samples contain a small proportion of quartz in the form of a fine grained angular sand. Thirteen samples from as many different depths were analyzed. These are seen to be all slightly magnesian, the MgO varying from 0.29 to 6.70 per cent. The silica (chiefly quartz) varies from 0.03 to 5.10 per cent. All the samples contain some phosphoric acid, but this together with the iron and alumina amounted at the most to only 0.40 per cent.

**The Genesis of the Talc Deposits of St. Lawrence County, N.Y.** By C. H. SMYTH, JR. *School Mines Quart.*, 17, 333-341.—The crystalline limestones of St. Lawrence County are frequently tremolitic, and pass into tremolite and enstatite schist. The talc is clearly due to the alteration of these anhydrous silicates. Its secondary origin is proved in most cases by its pseudomorphic character, retaining perfectly the form and structure of the original minerals, and showing every gradation in the process of alteration. The so-called veins of talc are, therefore, simply altered beds of tremolite and enstatite schist. The chemistry of the conversion of enstatite and tremolite into talc is expressed by the following equations:



The substitution of hydrogen for calcium in the latter reaction is quite in harmony with the generally accepted view that talc is an acid metasilicate,  $\text{Mg}_3\text{H}_2(\text{SiO}_3)_2$ . The essential agents of alteration are evidently provided by circulating water holding  $\text{CO}_2$  in solution, and many occurrences of talc pseudomorphs show that the change may occur under ordinary conditions of pressure and temperature. Considering its origin, the composition of the talc is surprisingly close to that demanded by theory, as is shown by the analyses which are given.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

## REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

W. O. CROSBY, REVIEWER.

**Notes on the Eclogite of the Bavarian Fichtelgebirge.** By DAVID HALE NEWLAND. *Trans. N. Y. Acad. Sci.*, 16, 24-29.—This fragmentary petrographic sketch is accompanied by analyses of the rock and of certain of its component minerals. The discussion is brief and develops no points of general interest.

**The Geology of Point Sal.** By HAROLD W. FAIRBANKS. *Bull. Dept. Geol. Univ. Cal.*, 2, 1-91.—This is a detailed study of a limited area of Cretaceous and Tertiary strata with associated volcanic rocks in the north-western part of Santa Barbara County, California. The petrographic descriptions are freely supplemented by chemical analyses of the various rocks, both sedimentary and igneous. The bituminous shales of the Miocene series embrace a white porcelain-like variety which gave:  $\text{SiO}_2$ , 86.92;  $\text{Al}_2\text{O}_3$ , 4.27;  $\text{CaO}$ , 1.60;  $\text{K}_2\text{O} + \text{Na}_2\text{O}$ , 2.48; loss on ignition, 5.13; total, 100.40. This agrees closely with an analysis by Lawson and Posada of the bituminous shale at Monterey. Two analyses of flint are also quoted for comparison. The author rejects the view that this rock is an acid soda rhyolite, and regards it as essentially of organic origin, a consolidated tripolite. The volcanic ash interstratified with the Miocene strata is proved by analysis to be an acid rhyolite, containing 74.841 per cent. of  $\text{SiO}_2$ . Augite-teschenite, previously described by the author as analcite dialase, forms large dikes in the gypsumiferous Miocene strata. This rock is of especial interest on account of the abundant occurrence of analcite in it. The author is confident that the analcite is secondary after some soda-rich original silicate, like nepheline. Analyses are given for the rock as a whole and for its chief constituents—augite, feld-

spar, and analcite. From the analyses the proportions of the component minerals are computed and found to agree very closely with the results of a mechanical separation by means of a heavy solution and magnet. An elaborate discussion of the composition and a comparison with European teschenites bring the author to the conclusion already stated that the analcite was derived from nepheline, although not a recognizable trace of nepheline now remains. Analyses are also given of gabbro, andesite, and spheroidal basalt. The paper concludes with a discussion of magmatic variation, the author's view being that the rocks in question have come up from a deep basic zone in the earth's crust—a wide-spread body of basic magma of nearly homogeneous composition. This primitive basic magma has experienced both primary and secondary differentiation in the chimneys subsequent to its eruption, through a variety of causes, Rosenbusch's theory of segregation in obedience to chemical affinity being regarded as the most generally applicable.

**Notes on the Occurrence of a Rich Silver and Gold Mineral Containing Tellurium, in the Griffith Lode, near Georgetown, Clear Creek County, Colorado.** By RICHARD PEARCE. *Proc. Col. Sci. Soc.*, Oct. 5, 1896.—The mineral occurs only in small quantities, associated with pyrite, galenite and chalcopyrite, in a feldspathic matrix containing small quantities of magnesite. The color is dark gray with a bright metallic luster; hardness about 3. An analysis by F. C. Knight of approximately pure material gave : Ag, 50.65 ; Te, 18.80 ; Pb, 9.34 ; Cu, 4.65 ; Fe, 4.00 ; Bi, 1.16 ; S, 8.06 ; MgCO<sub>3</sub>, 1.95 ; alloy of Au and Ag, 0.48 ; insoluble residue, 1.07 ; total, 100.16. The author refers the gold wholly to the alloy, which he found to be 725 fine, and regards the mineral as an intimate mixture made up as follows : Hessite, 51.22 ; argentite, 20.93 ; Cu<sub>2</sub>S, 5.82 ; FeS, 6.28 ; PbS, 10.78 ; Bi<sub>2</sub>S<sub>3</sub>, 1.45 ; Au and Ag alloy, 0.48 ; MgCO<sub>3</sub>, 1.95 ; insoluble residue, 1.07 ; total, 99.95. The Cu<sub>2</sub>S and FeS are supposed to be combined as chalcopyrite ; and it is noted that the relation between the hessite and argentite corresponds closely to the formula 2Ag, Te + Ag, S.

**Notes on the Occurrence of Tellurium in an Oxidized Form in Montana.** By RICHARD PEARCE. *Proc. Col. Sci. Soc.*, November 2, 1896.—No complete analyses are given ; but the author concludes that below the zone of oxidation sylvanite occurs with rich silver minerals.

**Sepiolite.** By E. HELMHACKER. *Eng. Min. J.*, 62, 80-82. This paper discusses the mode of occurrence of sepiolite in Asia Minor and other regions, its derivation from serpentine, and the varieties based upon differences of composition.

**Wolfram Ore.** By E. HELMHACKER. *Eng. Min. J.*, 62, 153-154.—The author describes the occurrence of the mineral wolfram with the tin ores of the Erzgebirge and other districts, discusses its influence in the manufacture of steel, gives analyses of the three grades obtained by concentration, and discusses the method of analysis.

**The Geology of the Fox Islands, Maine.** By GEORGE OTIS SMITH. *Dissertation at Johns Hopkins Univ.*, 1-76.—This thorough and every way admirable petrologic study embodies original analyses of several of the igneous rocks, including an andesite and an apophyllite.

**General Geology of the Cripple Creek District, Colorado.** By WHITMAN CROSS. *Ann. Rep. U. S. Geol. Survey*, 16, (part 2), 13-109.—The rocks of the Cripple Creek District include the pre-Cambrian granites, gneisses and schists, and the tertiary volcanics. The most characteristic product of the Cripple Creek volcano is the phonolite. This is chiefly composed of alkali feldspar and nepheline, with sodalite and nosean, and a pyroxene rich in alkali and iron. Four closely accordant analyses by Dr. Hillebrand are given, and three others are quoted for comparison. The proportions of SO<sub>3</sub> and Cl prove sodalite to be more abundant than nosean; the aegirine augite varies with the proportion of lime; zircon crystals are exceedingly rare, and the zirconia disclosed by the analysis is attributed to the rare mineral leavenite. From 25 to 40 per cent. of the rock is soluble in HCl, indicating a large amount of nepheline. A trachytic phonolite is next described, with a single analysis, which shows that it differs chiefly from the typical phonolites in the increased percentage of lime. The solubility test indicates a much smaller proportion of nepheline. A nepheline syenite occurring at one point is regarded as a granular representative of the phonolites. The analysis shows that although more basic it is very closely related to the phonolite magmas. The other volcanic rocks described are augite-syenite-porphyry, andesite, plagioclase-basalt and nepheline-basalt, tuff and breccia and rhyolite. These lithologic descriptions are introductory to a detailed structural study of the Cripple Creek volcano, chiefly as exposed in the numerous mines.

**Mining Geology of the Cripple Creek District, Colorado.** By R. A. F. PENROSE, JR. *Ann. Rep. U. S. Geol. Survey*, 16, (part 2), 111-209.—No part of the work of the United States Geological Survey deserves higher commendation than its splendid series of timely monographs on the economic geology of the country. The unique character of the Cripple Creek district makes the present contribution especially noteworthy and valu-

able. The brief introductory and historical sections are followed by a chapter on the ores. The gold occurs chiefly in combination with tellurium; but near the surface the tellurium occurs chiefly in oxidized forms, and the gold is mainly free. That this free gold has come chiefly from the oxidation of the telluride is proved by the angular shape of the pieces of gold, their pseudomorphic striation, their porosity and the presence of oxidized tellurium materials in the rusty coating of the gold. Hillebrand has proved the gold telluride to be calaverite, the proportion of silver being much too low for sylvanite. Auriferous pyrite also occurs, but is not deemed an important source of gold. Among the oxidation products of the pyritic ores is a mineral which Hillebrand has shown to be a hydrated ferric silicate related to chloropal. The analysis gave:  $\text{SiO}_2$ , 41.80;  $\text{Fe}_2\text{O}_3$ , 37.0;  $\text{H}_2\text{O}$ , 19.90;  $\text{CaO}$ , 1.10; total, 100.00. The widely distributed manganese oxide is supposed to be derived chiefly from the carbonate or silicate. In a few mines silver occurs in notable amounts, as shown by several analyses and assays; but these do not indicate clearly its mineralogical relations. Lead occurs only very sparingly, as galena or its oxidation products. Zinc also occurs sparingly as the sulphide, sphalerite, and a single analysis is given. Copper is one of the rarest metals in the district; but one occurrence of tetrahedrite containing 11.19 per cent. of silver is noted. Among the gangue minerals a purple fluorite is most characteristic. Besides quartz, there are hydrous forms of silica, including hyalite. The so-called jasper is proved by analysis to be a highly ferruginous opal. Along the line of the veins, especially, the feldspathic constituents of the rocks are extensively kaolinized, and three analyses are given to show that the composition of the kaolin is essentially the same whether derived from the granite, phonolite, or andesite. Calcite and gypsum are rather rare secondary minerals. The next chapters are devoted to the mode of occurrence of the ores, and the source and mode of deposition of the ores. The ores have been derived from the country rocks, both granitic and volcanic, at a considerable depth, and have been deposited largely through fumarole action, in fissures or fissured zones, with extensive replacement of the rocks.

**Economic Geology of the Mercur Mining District, Utah.**  
By J. EDWARD SPURR. *Ann. Rep. U. S. Geol. Survey*, 16, (part 2), 343-455.—This latest of the economic monographs of the Survey describes the most recently developed of all the great mining camps of the West. Like Cripple Creek, this is now distinctively a gold-mining camp, and one of a sufficiently unique character, for the gold ores remained undiscovered for many years within 100 feet of the now long abandoned silver mines.

There are two ore-bearing horizons about 100 feet apart near the middle of a great series of limestone strata, each occurring as an impregnation or replacement of limestone along the lower contact of an intrusive sheet of porphyry. The principal vein materials of the lower or Silver Ledge are silica, barium, antimony, copper, and silver; and of the upper or Gold Ledge, are realgar, cinnabar, pyrite, and gold. Very careful assays of the unaltered limestones, shales and porphyries show that the precious metals are very generally present in appreciable amounts; but the Silver Ledge contains only a trace of gold and the Gold Ledge practically no silver. The silver ores are especially distinguished by the fact that they do not contain a trace of lead. Complete analyses by Dr. Hillebrand, embracing over twenty determinations in each case, are given for the silver ore and for both the unoxidized and oxidized gold ores. The chapters on the origin of the ores are replete with interest for the student of chemical geology. The silver ores are regarded as aqueous deposits, but not as the product of a general aqueous circulation. The water which was intimately combined with the porphyry at the time of its eruption and was perhaps the motive cause of the eruption was separated from the lava at the moment of cooling and found its way into the adjoining rock. Being still intensely heated, and carrying in solution many of the chief elements of the eruptive mass, it exerted for a brief period a powerful altering force on the easily soluble limestone, and in the course of this alteration the ores were deposited. The mineralization of the Gold Ledge took place at a distinctly later period than that of the Silver Ledge, and the general nature of the phenomena indicates that the agents were gaseous rather than liquid; that they ascended along the open vertical fissures, probably from some uncooled body of igneous rock below, and impregnated the zone at the lower contact of the porphyry sheet, which was already altered and porous from the effects of the earlier Silver Ledge mineralization, with arsenic, mercury, and gold. The fact that the chief associated minerals of the gold are realgar and cinnabar, and that the gold itself was probably first deposited as the telluride, is regarded as a striking confirmation of this view.

**On the Occurrence of Vanadium in Scandinavian Rutile.**  
By B. HASSELBERG. *Astro-Phys. J.*, 5, 194-198.—The presence of vanadium was unexpectedly discovered in samples of the mineral rutile, from both Norway and Sweden, from a careful study of the spectrum obtained by the volatilization of the above mineral in the arc. Whether the amount present is sufficient for analytical determination remains an open question.

## GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

**A Revision of the Atomic Weight of Magnesium.** By THEODORE WILLIAM RICHARDS AND HARRY GEORGE PARKER. *Proc. Am. Acad. Arts and Sci.*, 32, 55-73.—Three samples of magnesium ammonium chloride were prepared by somewhat different processes, great care being used to remove all impurity. Portions of this salt were then gradually heated to redness in a platinum boat in a combustion tube in a current of dry hydrochloric acid, and the residual magnesium chloride was allowed to cool either in that gas or in dry nitrogen, which was then displaced by dry air. The apparatus was so arranged that the platinum boat could be pushed into a weighing tube and the glass stopper of the latter inserted within the combustion tube without exposing the salt to the air. The salt, after weighing, was dissolved in water. In one series of experiments an excess of silver nitrate was added, and the precipitated silver chloride was collected and weighed. In three other more reliable series the ratio,  $MgCl_2 : 2Ag$ , was determined by adding to the salt a nearly equivalent weighed amount of pure silver dissolved in nitric acid and estimating the slight excess of silver or chlorine in the liquid after allowing the precipitate to settle by comparative measurements of the degree of opalescence produced by adding to separate portions of it minute quantities of silver nitrate and ammonium chloride. The first three series of experiments consisting respectively of five, three, and five determinations gave 24.369, 24.380, and 24.365 as the atomic weight referred to oxygen as 16. The fourth series, consisting of six determinations, was made with even greater precautions than the preceding ones, two distinct samples of magnesium chloride and three of silver being employed. The results obtained are 24.360, 24.364, 24.362, 24.362, 24.363, and 24.363, giving as a mean 24.362, which the authors adopt as the final value of the atomic weight. This brief summary of the results is a sufficient comment on the wonderful accuracy of the work.

**The Velocity of the Reaction between Ferrous Chloride, Potassium Chlorate, and Hydrochloric Acid.** By A. A. NOYES AND R. S. WASON. *J. Am. Chem. Soc.*, 19, 199-210.—The authors present nine series of measurements which show that the reaction is one of the *third order*, its velocity being directly proportional to the concentration of each of the three substances; also six series on the effect of varying the temperature between 0° and 50°. It is shown that the latter effect can be expressed by the thermodynamical logarithmic equation of van't Hoff, whose applicability to several other reactions has already been

demonstrated by Arrhenius. The effect is one of the same order of magnitude as that in the case of other actions already investigated.

**A Recalculation of the Atomic Weights.** By FRANK WIGGLESWORTH CLARKE. *Smithsonian Miscellaneous Collections*, 1075, 1-370.—This valuable publication is a presentation and critical discussion of all the existing data relating to the combining weights of the elements.

**Mercuric Chloride.** By D. MCINTOSH. *J. Phys. Chem.*, 1, 298-300.—In explanation of the observation of Etard that the solubility of mercuric chloride in methyl alcohol is represented by two distinct curves intersecting at about 38°, the author has investigated the nature of the salt separating from the solution above 40° and below 35°. Above the former temperature small compact crystals consisting of the pure salt separate; while below 35° needle-like crystals form, which are shown, by analysis and by determining whether heat is produced or absorbed by the successive addition of varying quantities of alcohol to the salt, to have the composition  $HgCl_2 \cdot CH_3OH$ . The transition temperatures in pure methyl alcohol and in mixtures of it with water were determined by observing with the eye the point at which the needle-like crystals first make their appearance, and by noting the point during the cooling of the solution at which the thermometer reading remains constant for an appreciable interval of time. The results are tabulated.

**Mass Law Studies, I.** By S. F. TAYLOR. *J. Phys. Chem.*, 1, 301-303.—The author has determined at 20°, 25°, and 35° the quantities of water which can be added to various mixtures of alcohol and benzene, and the quantities of benzene which can be added to mixtures of alcohol and water, before separation into two layers takes place. The results differ widely from those previously obtained by Bancroft at 20°. The publication of two such discordant series of results from the same laboratory without any attempt to explain the discrepancy seems to the reviewer unjustifiable.

**Quintuple Points.** By WILDER D. BANCROFT. *J. Phys. Chem.*, 1, 337-343.

**Solids and Vapors, II.** By WILDER D. BANCROFT. *J. Phys. Chem.*, 1, 344-348.—Compare *this Rev.*, 2, 36.

**Distillation with Vapor.** By C. H. BENEDIKT. *J. Phys. Chem.*, 1, 397-402.—The author cites numerous previous observations showing that non-volatile substances are present in vapors in much larger amounts than would correspond to their

vapor pressures, and he describes an experiment of his own in which he distilled a saturated solution of naphthalene in ether in contact with solid naphthalene, analyzed the distillate, and found it to contain a proportion of naphthalene corresponding to a partial vapor pressure of 37 mm., which is more than four times greater than the vapor pressure of pure naphthalene. The author suggests that this may be due to an increase in the vapor pressure of the dissolved substance by the solvent or to a solubility of it in the vapor. The result of the author's experiment seemed so improbable, considering its discordance with the established laws of the vapor pressure of solutions, that the reviewer was led to repeat it; and he was not surprised to find that the distillate passing over between 62° and 82° (the thermometer-bulb being in the liquid) from a concentrated solution of naphthalene in ether left on evaporation at the ordinary temperature about 0.1 per cent. of the former substance instead of 8.8 per cent. as found by the author.

**Two Liquid Phases, I.** By WILDER D. BANCROFT. *J. Phys. Chem.*, 1, 414-425.

**A Triangular Diagram.** By WILDER D. BANCROFT. *J. Phys. Chem.*, 1, 403-410.—The author discusses the plan proposed by Roozeboom for representing, by means of an equilateral triangle the variations in composition of a phase consisting of three components.

**Cuprous Chlorid.** By J. K. HAYWOOD. *J. Phys. Chem.*, 1, 411-413.—Lescoeur has previously shown that cuprous chloride is partially decomposed by water into cuprous oxide and hydrochloric acid, and that successive portions of wash water contain equal quantities of hydrochloric acid until the chloride is completely converted into the oxide, a result in complete accord with the laws of equilibrium. The author has repeated the experiments; and he concludes from his own results that those of Lescoeur were purely accidental and due to the fact that the conditions under which the successive treatments of the chloride with water were made were so nearly identical. It is difficult to see how this could have been the case; for Lescoeur continued the washing until the chloride was entirely decomposed, so that the amount of it in contact with the water must have steadily diminished.

**A Contribution to the Study of Water Solutions of Some of the Alums.** By HARRY C. JONES AND E. MACKAY. *Am. Chem. J.*, 19, 83-118.—The article begins with a brief summary of the previous work relating to the composition of double salts in solution. The authors next describe, as preliminaries to their

investigations, a convenient apparatus for the preparation of pure water for conductivity measurements, and a volumetric method of determining aluminum. To prepare the pure water ordinary distilled water, to which potassium permanganate and sulphuric acid are added, is distilled from a large flask into a tubulated retort turned upwards containing an alkaline permanganate solution which is itself kept boiling, so that a continuous distillation occurs; joints are made with asbestos paper and a tin tube serves as a condenser. The authors determined the molecular conductivity of potassium, aluminum, and chromium sulphates and of six of the aluminum, chromium, and iron alums, at dilutions varying from 3 to 4000 liters. It was found that in dilute solutions the alums have a conductivity which is almost exactly the mean of the conductivities of their constituents; but that in more concentrated solutions (0.2—0.025 molecular weight per liter) the conductivity is somewhat less (9.2 per cent. in one case) than the mean. The authors have also determined the freezing-points of the solutions of the same salts, and find that the lowerings caused by the alums are in the more concentrated solutions 10-11 per cent. less than the sum of those of their constituents. The authors consider the differences both of conductivity and freezing-point to be greater than can reasonably be accounted for by the change in electrolytic dissociation of the salts on mixing, and conclude therefore that undissociated alum molecules probably exist to some extent in the more concentrated solutions, but that they are completely broken up in the more dilute solutions. Incidentally the authors have found that the very dilute solutions of the alums increase in electrical conductivity with time, a phenomenon already observed and discussed by Goodwin (*this Rev.*, 3, 22) in the case of ferric chloride.

H. M. GOODWIN, REVIEWER.

**The Multiple Spectra of Gases.** By JOHN TROWBRIDGE AND THEODORE WILLIAM RICHARDS. *Am. J. Sci.*, 153, 117-110.—The interesting investigations of the authors on the dual spectra of argon under the influence of a continuous and oscillatory discharge are extended in this paper to nitrogen, hydrogen, the halogens, and helium. The method employed is that previously described (*this Rev.*, 3, 22). A continuous discharge in nitrogen caused the gas to glow with a delicate pink light, and gave rise to a channelled spectrum. Introduction of a gap across which a brush discharge took place caused the glow in the capillary to become more blue, and the red lines in the spectrum to disappear. Introduction of a condenser, whereby the unidirectional was changed to an oscillatory discharge, caused a complete change in the appearance of the discharge; the glow became

bluish green, and the spectrum changed to the well-known bright-line spectrum of nitrogen. By gradually damping the oscillations by the introduction of a resistance or inductance in the circuit, the first spectrum gradually reappeared. The same was true of hydrogen; the usual four line spectrum is produced only by an oscillatory discharge; a continuous discharge causes the red glow in the capillary to change to white, and the spectrum to change to one composed of very many fine lines among which are the four characteristic hydrogen lines, by no means especially prominent however. The halogens likewise give two spectra according to the nature of the discharge producing them. With helium the difference of the two spectra is less marked. The bearing of the results on astro-physical problems is pointed out. The work is being extended to other gases under varying conditions of temperature and pressure.

**The Temperature and Ohmic Resistance of Gases During the Oscillatory Electric Discharge.** By JOHN TROWBRIDGE AND THEODORE WILLIAM RICHARDS. *Am. J. Sci.*, 153, 327-342.—The resistance which a rarified gas offers to the passage of an oscillatory discharge is very much less than that which it offers to a unidirectional one. The authors have determined the resistance of a Plücker's tube to an oscillatory discharge in the following way. Many hundred photographs of the oscillatory sparks of condensers of different capacities discharged through variable known resistances were taken as viewed in a very rapidly revolving mirror. A curve was then constructed with resistances as abscissae and the corresponding number of half oscillations determined from the photographs as ordinates. Plücker tubes were then substituted for the known resistances, and the spark again photographed. From the number of oscillations thus determined, the corresponding resistance of the tube was interpolated from the plot. The results of a large number of experiments with nitrogen and hydrogen are summarized as follows: 1. The resistance of a gas at low pressure to the oscillatory discharge is very small (5 to 10 ohms). 2. The resistance is in general greater, the less the quantity of electricity. 3. Down to a very small pressure this resistance decreases with the tension of the gas. 4. The form of the tube has an important effect on the resistance of the gas. 5. With the oscillatory discharge it is evident that the electrodes produce far less effect than with the continuous discharge.—The authors then discuss the cause of the different types of spectra produced by direct and oscillatory currents, favoring the view that the continuous discharge is the result of a "polarized condition in which the molecules are in some way bound together by the electric energy striving to force itself through them," while the oscillatory discharge is

accompanied by dissociation of the molecules. For the production of such dissociation an enormously high temperature is required, which, however, is entirely outside the bounds of measurement, owing to the brief period of the discharge. Bolometric measurements in a vacuum tube gave no indication of what this may be, as in such measurements only the mean temperature of the gas in the neighborhood of the bolometer is measured. The reviewer would raise the question whether the color and spectrum of a discharge may not be the result of a transformation of electrical energy into radiant energy, either directly or perhaps intermediately through chemical energy, rather than of a very high temperature arising from the transformation of the energy of the discharge into heat, especially in view of Pringsheim's experiments on heated gases and vapors, which go to show that gases cannot be brought to incandescence by heat alone.

**Does a Vacuum Conduct Electricity?** By JOHN TROWBRIDGE. *Am. J. Sci.*, 153, 343.—This question, which was answered affirmatively by Edlund, and more recently negatively by J. J. Thomson, is again considered in the light of the author's recent experiments on vacuum discharges. The principal resistance encountered in a high vacuum discharge resides at the boundary of the electrodes and the medium. When once this resistance is overcome and a discharge passes through the tube, the resistance of the tube to subsequent oscillations is equivalent to only a few ohms. The author concludes that the resistance of the Crookes' tube to a disruptive discharge diminishes as a perfect vacuum is approached. It should be remembered, however, that the actual resistance offered by a so-called "absolute vacuum" to the *initial* discharge increases almost indefinitely with the vacuum, and that only after a discharge has once passed and broken down the medium, thus presumably modifying in some way the residual gas in the tube, is the resistance reduced for succeeding discharges to the low value measured by Prof. Trowbridge.

**The Influence of a Static Charge of Electricity upon the Surface Tension of Water.** By E. L. NICHOLS AND T. A. CLARK. *Phys. Rev.*, 4, 375–388.—The surface tension of water was determined under different states of electrification by the method of drops. The potential to which the water was raised was measured by means of a modified form of Henley electrometer; and the temperature of the drops as they fell from the dropper measured by means of a thermo-element. It was found that the surface tension diminished—at first slowly, but above 6000 volts rapidly—with increasing voltage. This result was found to be independent of the sign of the charge; and preliminary experi-

ments indicate that the same relations hold true for other liquids than water.

**The Lead Cell.** By B. E. MOORE. *Phys. Rev.*, 4, 353-374.—The theory of accumulators as given by Le Blanc in his *Lehrbuch der Electrochemie* is accepted by the author and reproduced in some detail. A number of experiments on the electromotive force of accumulators during charge and discharge were made at noted intervals of time, particularly immediately after the closing of the circuit, the results being represented graphically. A very rapid change of the electromotive force was noticed during the first few seconds of each run, which is probably due to changes in concentration at the electrodes. The currents used ranged from 10 to 20 amperes, but the current density is not stated. For further discussion of the results, which the author considers to be in agreement with the theory, the reader is referred to the original article. The reviewer would remark that in the valuable paper by Tower on Peroxide Electrodes (*Ztschr. Phys. Chem.*, 18, 17), which has evidently been overlooked by the author, we have the most satisfactory theory yet offered of the positive (peroxide) electrode of the cell while the negative electrode consisting of Pb and PbSO<sub>4</sub> in H<sub>2</sub>SO<sub>4</sub> is simply a reversible electrode of the second kind, the theory of which is also well established (Goodwin, *Ztschr. Phys. Chem.*, 13, 621).

**Empirical Formulae for Viscosity as a Function of Temperature.** By A. WILMER DUFF. *Phys. Rev.*, 4, 404-410.—To obtain a formula expressing the dependence of viscosity on temperature for wide ranges of temperature the author integrates the equation:  $-\eta \frac{dt}{d\eta} = a + bt + ct^2$  (the equation of the "subsidiary curve of subtangents"), and obtains the following formulae containing four constants:  $\eta = c \left( \frac{t + \alpha}{t + \beta} \right)^n$  and  $\eta = c a - \tan a(t + \beta)$ . These formulas are tested with the data of Thorpe and Rodger and those of others. That the agreement should be better than can be obtained with a three-constant formula is self-evident.

**Sulfur and Toluene.** By J. K. HAYWOOD. *J. Phys. Chem.*, 1, 232-233.—The boiling-points of toluene and of xylene were found to be raised about 2° and 4°, respectively, by the addition of an excess of sulphur.

**An Examination of the Abegg Method of Measuring Freezing-Point Depressions.** By E. H. LOOMIS. *J. Phys. Chem.*, 1, 221-232.—The examination consists for the most part of a com-

parison of the author's method and results with those recently published by Abegg. Abegg's method is regarded as entirely free from objections in principle and "marks a positive advance in freezing-point methods;" but that it may be used to better advantage, the author emphasizes the necessity of making a larger number of independent determinations of each solution than Abegg has done in order to eliminate the indeterminate errors which a consideration of his results shows to be present. It is pointed out that the apparent constancy of Abegg's freezing temperatures as indicated by the constancy of his thermometer within  $0.0001^{\circ}$  for hours at a time, is undoubtedly due to the "inertia" of the mercury thread in the thermometer, and not to an actual constancy of temperature to this amount; for from the experience of the author the most sensitive thermometers do not respond to temperature changes of several ten-thousandths of a degree, when once the thread has become stationary.

**Osmotic Pressure and Variance.** By J. E. TREVOR. *J. Phys. Chem.*, 1, 349-366.—In this paper Gibbs' Phase rule expressed in the form  $v = n + 2 - r$ , where  $n$  is the number of independent substances present,  $r$  the number of phases, and hence  $v$  the degree of freedom or "variance" (according to the terminology of the author) of the system, is extended to systems containing any number of semi-permeable walls, or in other words, any number of phases in which the osmotic pressure varies from phase to phase. The general criterion is arrived at by the specific consideration of a number of simple and rather complicated systems, and may be formulated as follows:  $v = n + 2 + x + y - r$ , where  $v$ ,  $n$  and  $r$  have the same significance as above,  $x$  is the number of additional pressures due to the introduction of  $x$  osmotic walls, and  $y$  the number of separations of a component by a wall impermeable to it. For example in the system: solution, vapor, solvent, we have two independent chemical substances  $n$ , three phases  $r$ , one wall  $x$ , and no "separation," as the dissolved substance is present on but one side of the wall; hence the system has two degrees of freedom, or is divariant, since  $v = 2 + 2 + 1 + 0 - 3 = 2$ . Again, in the system: solution, solid salt, vapor, solution; we have  $n = 2$ ,  $r = 4$ ,  $x = 1$ , and  $y = 1$ , since the wall is impermeable to salt and it is present on both sides. This system is therefore divariant, since  $v = 2 + 2 + 1 + 1 - 4 = 2$ .

**A New Formula for the Wave-Lengths of Spectral Lines.** By J. J. BALMER. *Astro-Phys. J.*, 5, 199-209.—The author proposes the formula:  $\lambda_n = a \frac{(n+c)^2}{(n+c)^2 - b}$  or  $\tau_n = A - \frac{B}{(n+c)^2}$  for representing the line series of different spectra where  $a$ ,  $b$ ,  $c$ ,

A, B are constants,  $\lambda_n$  the wave length, and  $\tau_n$  its reciprocal. The claims made for the new formula are its simplicity and the fact that it is a closed function and not an abridged series (Kaysser and Runge), and therefore that it more probably (?) represents the natural law underlying spectral phenomena. The formula is tested on the helium lines. The proposed formula is nearly identical with that proposed by Rydberg several years ago, as noted in an appendix.

**Inner Thermodynamic Equilibria.** By J. E. TREVOR. *J. Phys. Chem.*, 1, 206-221.—The author discusses at some length the interpretation to be given to the several terms in the integral expression:  $\epsilon' = t\eta' - pv' + \sum \mu m'$  for the energy of a phase and to the terms resulting from its complete differential;  $d\epsilon = tdn - pdv + \sum \mu dm + \eta dt - vdp + \sum md\mu$ . While the first three terms of this equation refer to external energy changes involved by a change in the system, the last three refer to internal energy changes alone and for all reversible changes of state their sum is equal to zero. The article presents in a clear manner the relation to one another of the various forms of thermodynamic potential functions used by different writers. The views set forth are stated to be substantially the same as those published by L. Natanson in 1891 (*Wied. Ann.*, 42, 178).

## ANALYTICAL CHEMISTRY.

### ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

**The Mechanical Analysis of Basic Phosphatic Slags.** By H. W. WILEY. *J. Am. Chem. Soc.*, 19, 19-22.—The paper opens with a short sketch of the earlier literature relating to basic slags and the methods of their valuation. To bring about a mechanical analysis of the slags, the author proposes to agitate them vigorously with ninety per cent. alcohol. The particles remaining suspended for five minutes are separated, then those after a further interval of two and a half minutes, and the residue is sifted, using sieves with meshes one-tenth and one-quarter of a millimeter. The first two "separates" contain both the highest total and the highest available phosphoric acid. The data suggest that a partial separation, might advantageously be made by the manufacturers of basic slags, for the purpose of obtaining a more concentrated fertilizing material.

**Improvements in the Colorimetric Tests for Copper.** By GEORGE L. HEATH. *J. Am. Chem. Soc.*, 19, 24-31.—Standard ammoniacal copper solutions which are permanent for long

periods, may be prepared by replacing nitric acid by sulphuric acid after the solution of the pure copper in the former, provided a considerable excess of ammonia is added and the solution preserved in bottles with stoppers sufficiently tight to prevent any escape of ammonia. In the analysis of lean material for copper, a double precipitation of the iron and alumina by ammonia is found to yield better results, and in less time than either the precipitation by aluminum, or a single precipitation by ammonia.

**Some Present Possibilities in the Analysis of Iron and Steel.** By C. B. DUDLEY. *J. Am. Chem. Soc.*, 19, 93-108.—The paper gives a concise statement of the present attainments, both with respect to rapidity and accuracy, in the determination of carbon, graphite, silicon, sulphur, manganese and phosphorus in irons and steels. Valuable suggestions are also made respecting those points wherein these methods are still unsatisfactory, and upon which more research is desirable.

**The Determination of Sulphur in Pig Iron.** By A. A. BLAIR. *J. Am. Chem. Soc.*, 19, 114-115.—The author finds four kinds of sulphur in pig iron, the fourth being of a sort unacted upon by aqua regia, but oxidized by a fusion of the residue from the aqua regia with potassium nitrate. Bamber's method (*J. Iron Steel Inst.*, 1, 319) is recommended for the determination of sulphur in pig irons.

**A Rapid Method for the Determination of Silicon in Silico-Spiegel and Ferro-Silicon.** By C. B. MURRAY AND G. P. MAURY. *J. Am. Chem. Soc.*, 19, 138-139.—The finely crushed and sifted sample is dissolved in hydrochloric and sulphuric acids, the solution evaporated until only sulphuric acid remains, the ferric sulphate dissolved in hydrochloric acid. The silica is removed by filtration and tested with hydrofluoric acid. The operation may be completed in thirty minutes.

**A Method for the Complete Analysis of Iron Ores, with Notes on Särnström's Method of Determining Manganese.** By GEORGE AUCHY. *J. Am. Chem. Soc.*, 19, 139-153.—The author makes suggestions as to the principles involved in the Särnström method of separating iron and manganese, and proposes certain modifications. A procedure for an analysis of an iron ore involving the Särnström separation is given in detail, and additional comments are made on the determination of phosphorus in steel and cast iron. Compare also *J. Am. Chem. Soc.*, 17, 943; 18, 228; 18, 385; 18, 498.

**Standard Iodine for Sulphur Determinations.** By EDWARD K. LANDIS. *J. Am. Chem. Soc.*, 19, 261.—The author works

out a simple stoichiometrical calculation (such as could be made by any intelligent chemist), to find the quantity of a potassium permanganate solution necessary to liberate such an amount of iodine as will react with 0.5 gram of sulphur in the form of sulphuretted hydrogen.

W. H. WALKER, REVIEWER.

**Is Alcohol a Source of Error in Volumetric Analysis?** By LYMAN F. KEBLER. *Am. J. Pharm.*, 68, 667-675.—The answer to this question is of considerable importance when the value of alkaloids and alkaloidal residues is to be determined volumetrically. The "commercial alcohol" used by the author in this investigation was colorless, free from residue and foreign odor and of specific gravity 0.8179 at 15°. Solutions of Brazil wood, cochineal, haematoxylin, iodo-eosin, fluorescein, lacmoid, litmus, methyl orange, tropaeolin OO, phenolphthalein and rosolic acid were prepared in the usual manner, and five drops were taken as indicator for each titration. A tenth-normal sulphuric acid and a fiftieth-normal potassium hydroxide solution were then prepared, using haematoxylin as indicator, and after establishing the end-reaction with the other indicators, a set of experiments was carried out to determine the volume of the alkali solution required to neutralize a given volume of the acid solution when mixed with 50 cc. of water with diluted commercial alcohol, and with 94.5 per cent. commercial alcohol. The tabulated results conclusively show that with all the above indicators the commercial alcohol exerts a disturbing influence. This alcohol was then purified by fractionation, after treating successively with potassium hydroxide, tartaric acid, and silver nitrate; and its influence was investigated. The results show that in the experiments made with the commercial alcohol the disturbing action was due to some impurity; for the data obtained with the pure alcohol vary so little from those obtained from pure water, that, except with the indicators tropaeolin and methyl orange, the difference may be attributed to experimental errors. In the case of tropaeolin and methyl orange the stronger alcoholic solutions so interfere with the delicacy of the end-reaction as to render the results unreliable. Iodo-eosin and fluorescein also appear to be affected, but their end-reactions are so indistinct at best that little importance is attached to these variations. With the exception of the four indicators last named, the author thinks it safe to conclude that pure alcohol does not vitiate the accuracy of the volumetric determinations, but that commercial alcohol must be rigidly excluded.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

# REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

## ANALYTICAL CHEMISTRY.

### ULTIMATE ANALYSIS.

W. H. WALKER, REVIEWER.

**The Determination of Copper and Nickel in Smelter Matte.**  
By TITUS ULKE. *Eng. Min. J.*, 63, 164.—The sample is dissolved in a mixture of sulphuric and hydrochloric acids with the subsequent addition of a little nitric acid, and, after one evaporation to dryness, is redissolved in water and the copper determined by electrolysis with a current of one-fourth of an ampere. For the determination of nickel, the iron is separated by repeated precipitations with ammonia, and the nickel thrown out of the strongly ammoniacal solution at a temperature of 70°, by a current of two amperes.

**Blast Furnace Cinders and Their Analysis.** By J. M. CAMP. *Proc. Eng. Soc. Western Pa.*, 13, 18.—This paper, though very comprehensive, does not claim to contain anything that has not already appeared in chemical literature.

**A Rapid and Practical Method for Determining Carbon in Iron.** By J. GEORGE HEID. *Eng. Min. J.*, 63, 64.—The sample is treated with copper ammonium chloride in the usual manner, and the separated carbon is collected on an asbestos filter, where it is washed successively with water, alcohol, and ether; it is then transferred to a Rose crucible, dried at 120°, and weighed. A stream of oxygen is led into the crucible which is heated over a Bunsen flame, and the carbon is thus burned off in from three to five minutes; the difference in weight is the "total carbon." The "graphitic carbon" is obtained by dissolving the iron in dilute hydrochloric acid and determining the separated carbon as before.

## PROXIMATE ANALYSIS.

F. H. THORP, REVIEWER.

**Improvements on Dr. Squibb's Volumetric Method for Estimating Acetone.** By LYMAN F. KEBLER. *J. Am. Chem. Soc.*, 19, 316.—The author found Squibb's method (*J. Am. Chem. Soc.*, 18, 1068) unsatisfactory in two ways: a pure acetone must be used, which is not readily obtainable; and the end-reaction is too slow. After explaining his modified process, the author gives a table of comparative results by the methods of Messinger, Squibb, and himself, showing that Squibb's method gives results lower than his own.

G. W. ROLFE, REVIEWER.

**The Quantitative Determination of Carbohydrates in Food-Stuffs.** By W. E. STONE. *J. Am. Chem. Soc.*, 19, 183-197.—The author gives a detailed account of his method of separation and determination of the various carbohydrates in our common cereals and their products. The separations are all made in one sample, and the author claims an advantage of rapidity and convenience over previous methods. Many of the descriptions of processes, especially that of starch determination, are somewhat vague. The omitted details of the discrimination between invert sugar and other sugars, dextrin and "soluble starch," would not have been so trite as to be devoid of interest. Much of the subject-matter given has been previously published.

**The Quantitative Determination of Carbohydrates in Food-Stuffs, II.** By W. E. STONE. *J. Am. Chem. Soc.*, 19, 347-349.—The author draws attention to the obvious error in the starch estimations of his previous publications already referred to in these pages. He still finds a noticeable weight of the grain unaccounted for in his corrected analyses. The reviewer trusts that he will not be misunderstood when he reiterates that a more complete explanation of methods and more data should be given in the description of starch analyses. In no class of analyses does there exist more confusion, not only in methods of manipulation but of calculation, than in that of starch and starch products. Thousands of analyses become valueless simply from lack of published data that are absolutely necessary as a basis of comparison and correction. In the interests of science no space should be begrudged to this end.

**Notes on an Analytical Investigation of the Hydrolysis of Starch.** By G. W. ROLFE AND GEO. DEFREN. *J. Am. Chem. Soc.*, 19, 261-262.—The authors call attention to important errors of calculation and misprints in recently published papers. They also give a few additional deductions from the original data.

A. H. GILL, REVIEWER.

**A Technical Analysis of Hydrocarbons, Vapors, and Gases in Literature and Laboratory.** By W. H. BIRCHMORE. *Am. Gas Lt. J.*, 66, 445-446 and 478-480.—The author reviews briefly the various methods for gas analysis in use from 1875 to the present time, and states that the best description of these methods is given in *Thorpe's Dictionary of Applied Chemistry*.

**Heat of Bromination as a Means of Identifying Fats and Oils.** By BROMWELL AND MAYER. *Am. J. Pharm.*, 69, 145.—The authors have applied the method of Hehner and Mitchell, modified by Wiley, to many different oils. They use a tube jacketed with cotton and calcined magnesia, and use the oils and bromine in chloroform solution.

**A Brief Resume of Acetic Anhydride in Oil Analysis and a Modification of the Method for Estimating Menthol in Oil of Peppermint.** By L. F. KEBLER. *Am. J. Pharm.*, 69, 189-195.—The determination of the combined menthol is effected by submitting 10-12 grams of the oil to the Koettstorfer test. Each cubic centimeter of normal sodium hydroxide solution is equivalent to 0.156 grams of menthol in combination as an ester. For the total menthol, 10-12 grams of oil are subjected to the usual acetylating process, and treated as above. By deducting the amount of menthol in the form of esters from the total quantity found, the amount of free menthol is obtained. The process can be easily carried out in three hours. The author states that in the examination of oil of peppermint the following points should be taken into consideration:

(1) Specific gravity at 15° C., which in the eight samples examined varied from 0.9065 to 0.9147; (2) the boiling-point, which varied from a little below 200° C. to about 230° C.; (3) amount of menthol. The combined menthol varied from 3 to 16 per cent., the total from 30 to 80 per cent. These data, together with the aroma and identity tests, will show the character of almost any sample.

## TECHNICAL CHEMISTRY.

F. H. THORP, REVIEWER.

**Manufacture of Albumen at Chinkiang.** By A. C. JONES. *U. S. Consular Rep.*, 53, 386.—This deals with the preparation of albumen from ducks' eggs. The eggs are broken and the yolks separated from the whites. The whites are then stirred until uniformly mixed, and then dried in shallow tin pans, at a temperature of 40° to 50° C. The drying occupies about 70 hours. Sometimes the albumen is put into vats and allowed to ferment, the process being hastened by the addition of some

chemical, the nature of which is not revealed. The impurities rise in the froth, or settle to the bottom, and the clear albumen is drawn off and dried as above. The yolks are stirred through sieves and then mixed with salt, borax, and other chemicals. The thick, orange-colored liquid is filled into barrels and shipped. Its chief use is in the leather industry, for dressing. The chemicals used in preparing the albumen and yolk are said to be salt, borax, acetic acid, ammonia, boracic acid, and calcium chloride, but the quantities used and the methods of their employment are not stated.

**Asphalt and Asphalt Pavements.** By GEO. W. TILLSON. *Proc. Am. Soc. Civil Eng.*, 23, 179-199.—Regarding the composition of asphalt, the author quotes Peckham, Boussingault, and Endemann. The geographical distribution of asphalt deposits is also shown, followed by an account of the methods of obtaining and refining Trinidad, California, Bermudez, Utah, Kentucky, Indian Territory, and European asphalts; their physical properties are given, and in most cases also the chemical composition, but no authorities are quoted for the analyses. The greater part of the paper is devoted to the use of asphalt for pavements, and this is treated from the engineering and not from the chemical point. The author holds that a chemical analysis is of no particular assistance in forming an opinion of the suitability of an asphalt for a given pavement; it may however be of value in determining the amount of flux to be added for any given purpose. The refined asphalt should contain 50 to 60 per cent. of bitumen, which should be composed of about 75 per cent. petrolene, and 25 per cent. asphaltene.

**Notes on Portland Cement Concrete.** By ANDREAS LUNDTEIGEN. *Proc. Am. Soc. Civil Eng.*, 23, 135.—The author discusses the advantages derived from the addition of finely powdered siliceous material to Portland cement for concrete. He quotes Michaëlis to the effect that a large part of the lime in Portland cement is set free during the hardening, and also concludes from his own observations that this is true. The lime thus set free, may take up carbon dioxide from the air and is then rendered non-injurious, or it may be dissolved away by water, leaving the concrete porous, or in case sea-water reaches the concrete, the salts it contains will combine with the calcium hydrate to form double salts, which crystallize, or swell, and cause disintegration of the concrete. The author recommends the addition of a siliceous material which he calls *sil*. It is a volcanic ash from Nebraska, Colorado, and other places. Analysis shows its percentage composition to be: Silica, 71.78; titanic acid, 0.80; alumina, 12.71; iron oxide, 2.29; magnesia, 0.35; lime, 1.01; water of constitution, 4.52; alkalies (by difference),

6.54. Ash containing a large amount of water of constitution, is considered best for this use. The siliceous material combines with the free lime. Numerous tables showing the effect of such additions are given. The ultimate strength appears to be considerably increased.

**European Portland Cement Industry.** By FREDERICK H. LEWIS. *Eng. Record*, 35, 312, 334, 378, 403, 444, 466.—This paper gives a description of several manufacturing establishments visited by the author while traveling abroad.

A. H. GILL, REVIEWER.

**Analysis of Popo Agie, Lander and Shoshone Petroleum.** By E. E. SLOSSON. *Univ. Wyom. Bull.*, 2, 21-34.—About 60 kilograms of the Popo Agie oil were distilled, and collected in 52 fractions, the flashing and burning points, and the specific gravity of each of which were determined. Another sample was treated similarly, except that superheated steam was introduced after the kerosene had distilled off, which produced a larger proportion of products similar to lubricating oils. The results of the experiments seem to indicate that the commercial products would be, in percentages, about as follows: Naphtha, 2-5; kerosene, 30-40; lubricating oil, 35-50; paraffin, 3-5; coke, 7-10; and gas, 10-12. Lander petroleum is much lighter than the usual Wyoming oils, while Shoshone petroleum is very heavy, and, like the Popo Agie, contains sulphur.

**The Presence of Hydrogen, Hydrocarbons, and Nitrogen Peroxide in Boiler Furnace Gases.** By R. S. HALE. *Eng. News*, 37, 107.—The author points out the fact that the absence of carbon monoxide is not a proof of the absence of free hydrogen or hydrocarbons. He shows that oxygen has a greater attraction for carbon than hydrogen at temperatures about 600° C. In calculating the distribution of the oxygen entering the grate nearly 0.8 per cent. frequently remained unaccounted for. It was thought this might be due to the presence of oxides of nitrogen, and upon examination it was found that in one case 0.9 per cent. of oxides of nitrogen was actually formed.

**The Calorific Value of Certain Coals as Determined by the Mahler Calorimeter.** By N. W. LORD AND F. HAAS. *Eng. News*, 37, 188-189.—The authors give the ultimate chemical analysis and heating value of forty samples of Ohio and Pennsylvania coals. The varieties were Upper Freeport, Ohio, Pittsburgh, Darlington, Hocking Valley, Thacker, West Va., Pocahontas, and Mahoning. To prevent portions of coal from being blown away by the oxygen, it was compressed into cylinders. The agreement of the calculated results by Dulong's for-

mula with the calorimetric results is remarkable, the maximum difference being 2 per cent., and the minimum 0.1 per cent. This is a trifle greater than the results of which ultimate analysis would yield, the possible error of the latter being for hydrogen 0.5 per cent., for carbon 0.2 per cent. This would cause an error in substitution in the formula of 1.4 per cent. They could find no relation between the "fixed carbon" and the heating value, but they found that the coal from a given seam extending over considerable areas, may be regarded as essentially of uniform heating value.

**Calorimetry.** By C. D. JENKINS. *Am. Gas Lt. J.*, 66, 442.—The article gives the results of tests made with the Junker Gas Calorimeter on various gases, both coal and water. It suggests that the proper standard for comparison is gas saturated with moisture at 60° F. and 30 inches barometric pressure. The apparatus gave with hydrogen 326.8 B.T.U., as against 328.8 obtained by Berthelot.

**Calorimetry and Heat Unit Value of Gases.** By F. B. WHEELER. *Am. Gas Lt. J.*, 66, 518.—The author compares the calorific power of various gases obtained by calculation with those obtained by direct determination with a calorimeter. He uses for the theoretical calculation Thomson's figures expressed in English units (B.T.U.) as follows :

CO, 348; H, 349; { C<sub>2</sub>H<sub>4</sub>, 1673 } Usually figured as "Illuminants" = 2000 B.T.U.  
CH<sub>4</sub>, 1065; C<sub>6</sub>H<sub>6</sub>, 4010; { C<sub>3</sub>H<sub>8</sub>, 2509 }

At 32° F. and 29.92 inches. To reduce the heat units thus found to the standard adopted in calorimetric work, *viz.*, gas saturated with moisture at 60° F. and 30 inches, multiply by 0.9298. It was found that the theoretical results agreed with the practical within about one per cent.

**Comparative Tests of Light Secured and Operating Expense of the Welsbach Lights and Oil Lamps.** By H. D. WALBRIDGE. *Am. Gas Lt. J.*, 66, 405.—It was found that the Welsbach burner gave 84.6 candle power per hour, at a cost of 0.3 cent for gas and 0.1 cent for mantles. A good oil lamp, with round wick with central draft, gave 30 candle power and cost 0.48 cents per hour; while the B. & H. oil lamp gave 37.5 candle power and cost 0.54 cent per hour. Gas was reckoned at one dollar per 1000 cubic feet, and kerosene 12 cents per gallon.

## BIOLOGICAL CHEMISTRY.

W. R. WHITNEY, REVIEWER.

**The Gelatin from White Fibrous Connective Tissue.** By WILLARD G. VAN NAME. *J. Expt. Medicine*, 2, 117-129.—

The aim of the author has been to obtain a pure sample of one of the several probably distinct compounds known as gelatins, and to determine its chemical composition and properties, so that the exact relationship between gelatin and albumin may be made clear. As source of the gelatin the author chose the collagen of tendons from oxen. After extraction with water the finely ground material was treated with alkaline pancreatic juice. By this treatment tissue elements other than the collagen were dissolved. This was filtered from the solution, washed with water, and finally dissolved in boiling water. The concentrated gelatin solution was poured into a large volume of 95 per cent. alcohol and the precipitated product washed with absolute alcohol and with ether until it became brittle. It was then pulverized and extracted with ether to remove fat, dissolved in water, and again precipitated by alcohol, washed, etc., as before. The dried product was then analyzed. Samples were also prepared from ox tendons by three ways differing somewhat from the above. The results of the analyses of the different samples agree very well with one another, the average composition of the ash-free gelatin being : Carbon = 50.11, hydrogen = 6.56, nitrogen = 17.81, sulphur = 0.256, oxygen = 25.24, ash = 0.325. The chemical properties of the four samples were found to be identical. Many of the characteristic reactions of pure gelatin are given, including a study of its precipitability by many acids and salts.

**The Relative Strength of Antiseptics.** By LOUIS KAHLENBERG. *Pharm. Rev.*, 15, 68-70.—After a brief historical account of the advance of the theories of solution, the author summarizes the valuable and instructive work of himself and True (*Botanical Gazette*, 22, 181), and of Heald (*Botanical Gazette*, 22, 125), upon the connection between the toxic action of aqueous acid, basic, and salt solutions upon various plants, and the condition of dissociation of these substances. The recently published work of Paul and Krönig (*Zeit. phys. Chem.*, Dec., '96), on the action of chemical reagents on bacteria is carefully reviewed. The author finds in this last, a confirmation of the views previously advanced by himself and True regarding the connection between electrolytic dissociation of compounds and their toxic or antiseptic action.

**Formic Aldehyde; Its Practical Use.** By F. C. ROBINSON. *Maine State Board of Health, 9th Report*, 1-24.—In 1893, a German chemical manufactory put upon the market a 40 per cent. aqueous solution of formic aldehyde, which they called formalin, and for which very valuable disinfectant properties were claimed. It seemed possible that this new germicide might soon replace all others, both because of its powerful

germicidal effect and of the safety to the ordinary furnishings of rooms, paintings, fabrics, etc., accompanying its use. Mr. Robinson has given the gaseous aldehyde a practical trial and ingeniously devised an effective form of lamp which produces the aldehyde in the room where its use is desired. The alcohol vapor is changed to aldehyde by glowing platinum-black deposited upon a perforated asbestos disk, which partly covers the vessel containing the alcohol. He states among other important facts, that the aldehyde from two liters of alcohol, in a room of 3000 cubic feet capacity, destroyed typhoid and diphtheria cultures even when these "were rolled up in a mattress and the whole tied into as compact a bundle as possible." Experiments with the aqueous solutions were also made, but the vaporizing treatment was more successful. The article contains two illustrations showing the construction of the lamp above mentioned.

**A Chemical Study of the Secretion of the Anal Glands of Mephitis Mephitica (Common Skunk), with Remarks on the Physiological Properties of this Secretion.** By THOMAS B. ALDRICH. *J. Expt. Medicine*, 1, 323-340.—The secretion was subjected to fractional distillation. The distillate of which the boiling-point was 100°-110° contained about 35 per cent. of sulphur and the author analyzed the mercaptides produced by addition of lead acetate, mercuric chloride, and mercuric oxide to alcoholic or ethereal solutions of this distillate. The results show the probable presence of primary normal butyl mercaptan, together with small quantities of higher mercaptans. That portion of the secretion boiling above 130° contains no mercaptans. The sulphur which it contains is thought to be combined with some basic nitrogen radical.

**The Occurrence of Raffinose in American Sugar Beets.** By W. E. STONE AND W. H. BAIRD. *J. Am. Chem. Soc.*, 19, 116-124.—As the result of investigation of the non-crystallizing sirups from a Nebraska beet sugar refinery, the authors conclude that raffinose occurs in the juices of the American sugar beet in appreciable quantities. Photographic reproductions of crystals of pure sucrose, raffinose, and a mixture of the two show the marked effect of the presence of even a small proportion of the latter in causing the mixture to crystallize in elongated, sharp-pointed crystals, much more like those of pure raffinose than sucrose.

**Marrubiin and Its Dichlorine Derivative.** By HARRY MATUSOW. *Am. J. Pharm.*, 69, 201-209.—The author reviews the work already done by Harms, Kromayer, Hertel, and Morrison, and then describes his own investigations. He details

carefully the isolation and purification of marrubiin and describes its properties, both physical and chemical. Results of analyses made by him are given, which show that marrubiin is not a glucoside, as was formerly believed. He also describes his preparation of the dichlorine derivative of marrubiin, gives its composition as derived by analyses, and states its physical properties.

**The Phenol-Content of the Oil of the Monarda Fistulosa (L).**

By E. J. MELZNER. *Pharm. Rev.*, 15, 86-87.—This article, which is a further contribution of the author's work on the Wild Bergamot oil, contains three tables of results. These show the percentage of phenol in a dozen samples, as determined volumetrically and by titration with iodine solution, also the yields of oil from given weights of stems, leaves, flowers, and fruit of the plant, together with the specific gravities of the oils obtained. Comparisons with results of previous years are also given.

**The Presence of Starch and Strontium Sulphate in Opium and their Influence on Assaying.** By LYMAN F. KEBLER AND CHARLES H. LAWALL. *Am. J. Pharm.*, 69, 244-250.—The authors have found these ingredients in samples of commercial opium and the fact that all cases examined in one consignment showed practically the same quantities of impurity, leads them to conclude that a "manipulation" of large quantities of opium occurs before it is packed in the cases. As the morphine present is always well above the legal requirements it would be interesting to know the reason for the adulteration, if such it is.

**Gelsemium.** By L. E. SAYRE. *Am. J. Pharm.*, 69, 234-235.—This may be considered as a conclusion of the author's previous article on the subject (*ibid.*, 69, 8-13). Analyses of the rhizomes, roots, and stems are given, showing that the gelsemine alkaloid, and gelsemic acid do not occur in the stem but only in rhizome and roots, so that admixture of the stems with the commercial roots is to be considered an adulteration.

**Gelsemic Acid.** By VIRGIL COBLENTZ. *Am. J. Pharm.*, 69, 228-231.—The author, after giving the brief history of this vegetable acid, points out an important source of error in previous analyses of the substance. He finds that a part of the carbon always separates in the combustion tube, in an incombustible graphitic form. Five different methods of combustion were tried and in none was the oxidation complete. A description of the wet combustion method using chromic acid in sulphuric acid, as employed by him, is then given, although this method also failed when gelsemic acid was analyzed. The analyses of

bromo and acetyl derivatives, which were more successful, the author does not give, as he intends to study their molecular weights with an aim to determining their formulas.

**Note on Phospho Cereal.** By T. H. NORTON. *Pharm. Rev.*, 15, 46.—Results of analyses of the so-called phospho cereal and its decoction are given. The sample contained 5.18 per cent. of phosphorus, calculated as  $P_2O_5$ . Of this about one-quarter was extracted by fifteen minutes' boiling with water and less than one-half in two hours. Phosphites and hypophosphites were not present in the decoction, all the phosphorus being present as phosphoric acid. By this latter expression is doubtless meant phosphate instead of free acid.

**The Proteose of Wheat.** By THOMAS B. OSBORNE. *Am. Chem. J.*, 19, 236-237. Exceptions are taken to the statement of Teller (*ibid.*, 19, 65) that the proteose and proteose-like body discovered in saline extracts of wheat flour by Osborne and Voorhees is gliadin. The author repeats the statement of the original article (*ibid.*, 15, 404) that the proteids of the extract were separated from the gliadin by ammonium sulphate solution, in which this body is insoluble. He believes that the proteose which was found in this salt solution cannot be gliadin.

**Proximate Analysis of Orris Root.** By S. ALLEN TUCKER. *Am. J. Pharm.*, 69, 199-200.—The author gives the results of his experiments upon the granular substance, which was ground fine and extracted with petroleum ether, ethyl ether, alcohol, water, etc. His results for moisture and ash determinations, as well as of the qualitative analysis of the ash, are also given. Unfortunately, as no descriptions and details of the processes he employed accompany the article, the numerical values must be accepted with caution.

**Parthenium Hysterophorous.** By H. V. ARNY. *Am. J. Pharm.*, 69, 169-180.—This is a continuation of work done by the author on this "common weed of Jamaica." Following a description of the plant, its blossoms, etc., the author states that besides starch, wax, gum, and mineral salts, there is also present an active principle to which the bitterness of the plant is due. This is obtained from the alcoholic extract of the drug by evaporation, solution in water, and extraction with chloroform. An improved process of extraction is also given. A well crystallized body was obtained, and its melting-point found to be 168-169° C. Its solubility in various reagents is given. The author is led to reject the belief that the body is either an alkaloid or glucoside, but considers it probably similar to santoni.

**The Rotary Properties of Some Vegetable Proteids.** By ARTHUR C. ALEXANDER. *J. Expt. Medicine*, 1, 304-323.—The author has determined the specific rotary powers of the globulins of hempseed, flaxseed, and Brazil nuts, in aqueous solutions of salts, acids, and alkalies. The specific rotary powers differed with different salt solutions, decreased in general with the percentage of the proteid in solution, and changed but slightly with the temperature.

**Changes in and Additions to Methods of Analyses Adopted at the 13th Annual Meeting of the Association of Official Agricultural Chemists.** By H. W. WILEY. *U. S. Dept. Agr. Circular No. 2*, 1-6.—This pamphlet is a supplement to the official methods of Bulletin No. 46, consisting of corrections and substitutions to be interlinedated into that report. The methods for analysis of fertilizers, soils, foods, and feeding-stuffs, tanning materials, and fermented liquors have all been improved. These corrections are many of them very important.

E. H. RICHARDS, REVIEWER.

**California Walnuts, Almonds, and Chestnuts; their Composition and Draft upon the Soil.** By E. W. HILGARD. *Cal. Expt. Sta. Bull.*, 113, 1-15.—Nuts are a concentrated form of food. The walnut and almond kernels contain respectively 65 and 58 per cent. of oil, and 17 and 25 per cent. of proteids, while the chestnut yields about 11 per cent. of oil and of proteid, and 75 per cent. of carbohydrates, or nearly as much as prunes and apricots. The chestnut may, therefore, take the place of cereals, and the walnut and almond that of meats, under certain conditions.

**Chemical Survey of the Water Supplies of Illinois.** By A. W. PALMER. *Preliminary Rep.*, published by the Univ. of Ill., 1-98.—This report is a valuable addition to our knowledge of the character of water supplies of the United States, and will well repay close study. "The aims of the survey include the determination of the present sanitary condition of the supplies drawn from the lakes, the streams, and the wells of the State; the determination of the normal condition of the contaminated waters; the formulation of local standards of purity based upon the results of analyses of water derived from unpolluted sources; the provision of such means as shall afford to citizens of the State opportunity to obtain immediate information regarding the wholesomeness of the potable waters in which they are directly interested; and the prevention and dissemination of disease from the use of impure water." Although the conditions of work in a State university demand the analysis of miscellaneous

samples, collected under unknown conditions by untrained persons, and consequently render the results obtained from this class of water somewhat uncertain, the information given by the figures tabulated for 802 samples of such water is most interesting to all who have to do with the sanitary conditions of the Middle West. Of far more interest to the chemical and sanitary engineer are the results of the periodic examinations of wells in various parts of the State for the purpose of determining the character of the normal ground water of the State. The importance of this part of the work is evident from the statement that more than half the inhabitants of the State depend upon wells for their water supply. A comparison of the figures tabulated for the comparatively shallow wells shows a greater proportion of nitrates to chlorine than is usual in the waters of the East. Even in the deep drift wells the nitrates vary very much more than the chlorine. This is possibly due to the passage of the water through the rich prairie soil, presumably higher in nitrates than the poorer soils of the East, or to a lessened use of salt in the ordinary household operations. It would seem rather premature to establish standards before determining some of the causes of the unusual variations observed even in the best waters. The periodic analyses of the several surface waters are of great interest for reference and comparison. The plans of work and the methods of analysis used are, for the most part, taken from those published in the reports of the Mass. State Board of Health.

**Dietary Studies at the Maine State College in 1895.** By WHITMAN S. JORDAN. *U. S. Agr. Expt. Sta. Bull.*, 37, 1-57.—This Bulletin contains the records of a large number of analyses of food materials and gives other data for the calculation of dietaries. The conclusions in regard to the use of milk in place of meat are somewhat influenced by the fact that a new manager, during the first weeks of service, would naturally use more meat than in the later time when he had gained experience. Milk may be a cheap food when the whole ration is a somewhat expensive one, when the milk can be bought at the low price of 4 cents per quart, and when the meat used costs 10 to 20 cents per pound; but when the daily expense must be limited to an outlay of 9 to 15 cents and milk costs 5 to 6 cents per quart, while beef may be had at 6 cents per pound, the conclusion does not hold. More data are needed before we can accept, as settled, the statement that the free use of milk lessens the use of other foods.

**Sand Filtration of a Public Water Supply.** By JAMES O. HANDY. *Proc. Eng. Soc. Western Pa.*, 1897, 1-57.—The records of a year's working of an experimental filter used in connection with the city water supply of Pittsburgh, Pa., are given in detail,

together with a considerable number of chemical and bacteriological results.

**Brief Comments on the Materia Medica, Pharmacy, and Therapeutics of the Year Ending October 1, 1896.** By E. H. SQUIBB. *Squibb's Ephemeris*, 4, 1776-1923.

### AGRICULTURAL CHEMISTRY.

F. H. THORP, REVIEWER.

**Analyses of Fertilizers.** *Agr. Ex. Sta. Bull. Ky.* No. 65; *Me. No. 33*; *Md. No. 45*; *Mo. No. 34*; *N. J. No. 117*; *Vt. No. 57*; *Wis. No. 57*.

**Basic Slag as a Fertilizer.** By F. E. THOMPSON. *Scientific Am. Suppl.*, 43, 17659.—The author gives a resumé of the published reports of the various State Agricultural Experiment Stations of the United States on the use of basic slag as fertilizer.

**Effect of Bisulphide of Carbon on the Vitality of Seeds and Plants.** By M. H. BECKWITH. *Del. Agr. Exp. Sta. Rep.*, 1895, 152.—The germination of wheat treated with carbon bisulphide before planting, was not affected to any extent. Strawberry plants were injured by exposure to the fumes before planting, but when growing no injury was noticed.

**The Bleaching of Nuts by Dipping.** By E. W. HILGARD. *Cal. Agr. Col. Bul.* No. 113.—This paper gives an account of the use of sodium hypochlorite and bisulphite solutions, for bleaching the shells of nuts.

**Ammoniacal Solutions of Copper Carbonate.** By C. L. PENNY. *Del. Agr. Sta. Rep.*, 1895, 206.—The author finds that dilute ammonia will dissolve more copper carbonate than stronger solutions. For the preparation of fungicides, the ammonia should be diluted nine-fold before dissolving copper carbonate in it, and this solution is further diluted one hundred-fold before use.

G. W. ROLFE, REVIEWER.

**The Insoluble Carbohydrates of Wheat.** By H. C. SHERMAN. *J. Am. Chem. Soc.*, 19, 291-316.—This is an important paper giving in much detail the preparation of many of these carbohydrates, their characteristic reactions, and the more approved methods for their determination. A brief review is given of the work done to solve the much discussed question of the food value of the celluloses and pentosans.

E. H. RICHARDS, REVIEWER.

**Sorghum as a Forage Crop.** By THOMAS A. WILLIAMS. *U.S.*

*Dept. Agr. Farmers Bull.*, 50, 1-20.—Beside the discussion relating to the cultivation of sorghum, there are given tables showing the results of chemical analyses of the plant and seeds, and a comparison with analyses of corn.

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## APPARATUS.

A. H. GILL, REVIEWER.

**Note upon an Improved Specific Gravity Bottle.** By E. R. SQUIBB. *Squibb's Ephemeris*, 4, 1771-1775.—The usual form of bottle with the neck ground in, is modified by graduating and calibrating this neck, so that the bottle may be used for temperatures from 0° to 25°.

**Some Apparatus for the Technical Laboratory.** By E. S. JOHNSON. *J. Am. Chem. Soc.*, 19, 281.—The article describes apparatus for the measuring of reagents, filtration, and solution with the aid of heat. For details reference must be made to the illustrations in the original paper.

**A New Calibrated Weighing Flask.** By G. L. HEATH. *J. Am. Chem. Soc.*, 19, 198.—The improvement consists of a collar ground upon the ordinary flask and a cap to fit it. This flask has the advantage that it can be stoppered without danger of sticking.

**The Use of Aluminum for Condensers.** By T. H. NORTON. *J. Am. Chem. Soc.*, 19, 153.—It was found that aluminum possesses the same advantages over glass as tin, but is much lighter and a better conductor of heat; hence it is better adopted for use with low boiling substances.

**A New Laboratory Grinder.** By C. A. BUCK. *J. Frank. Inst.*, 1897, 194.—It has been in use in the laboratory of the Bethlehem Iron Co. for five hours a day for three years and given satisfaction. It will grind a charge of 30 grams of refractory magnetite from 80 mesh to an impalpable powder in fifteen minutes.

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## METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

**The Smelting of Zinc-Lead Sulphides.** By L. KLOZ. *Eng. Min. J.*, 63, 358.—In smelting zinc-bearing lead ores the zinc is carried off by the gases, the slag, and the matte, little of it entering the lead. The zinc carried off by the gases forms wall accretions to some extent which interrupt the descent of the charges; zinc oxide or silicate being difficult of fusion makes the slag less fusible and causes particles of matte to remain sus-

pended in it, thus enriching it. In the large Rhodes' reverberatory furnace of Leadville, Colo., matte and slag tapped from the blast-furnace are given time to separate. In this way waste slag with one per cent. lead and 0.5 ounce silver per ton is obtained from slags running as high as six per cent. lead and 10 ounces silver.

**The Distribution of the Precious Metals and Impurities in Copper, and Suggestions for a Rational Mode of Sampling.** By E. KELLER. *J. Am. Chem. Soc.*, 19, 243-258.—This paper is the first systematic investigation of the subject that has appeared in print. Experience teaches that precious metals and impurities are unevenly distributed in metallic copper. A careful investigation of blast-furnace, reverberatory-furnace, and converter coppers of different degrees of purity, shows that there is little regularity in the uneven distribution. In some cases the foreign elements concentrate toward the center of solidification (which lies above the geometrical center, as the metallic mold draws off more heat from the bottom than the air at the top), in others they concentrate toward the outside. Hence, ordinary methods of sampling bars or pigs give unsatisfactory results. What is required is a form of sample bar in which the distribution shall be even, and in pouring the ladle must be hot enough to prevent any sculling, as the liquid part is sure to show a different percentage of precious metal from that which solidifies on the ladle. A sample bar (or plate), the thickness of which is small in comparison with the length and width, has the desired form, as the concentration from side to center cannot go farther than a distance equal to the thickness of the plate, because at that moment the entire plate has solidified. The border of the plate for a distance equal to the thickness of it will show an irregular distribution, within the border, concentration having taken place in one direction only; a correct sample will result, if the plate be punched or drilled through. The tests were made on plates 15 inches square and one inch thick. In trying to give an explanation of the irregular distribution of impurities, the author first ascertained by experiment that a charge of molten copper remained uniform in composition, when it had once been made so by thorough agitation and mixing. The different elements show different degrees of concentration. This, in a general way, excepting sulphur, corresponds with their melting-points, the more readily fusible the metal, the greater is the unevenness of distribution. Atomic weight and specific gravity do not appear individually to have any bearing upon the subject, but if the concentration is compared with the atomic volumes of the elements, there appears to be a correspondence, the concentra-

tion being the largest, where the difference in atomic volume is greatest.

**Phosphor Bronze.** By M. H. WICKHORST. *Foundry*, 10, 53-57; *Iron Age*, 59, No. 12, 2-3.—This paper, read before the Western Foundrymen's Association, treats, in a general way, of bronzes, their properties and manufacture. Of special interest is a bronze with six per cent. phosphorus made by the Chicago, Burlington, and Quincy Railroad Company's brass foundry at Aurora, Ill., in order to have phosphorus in convenient form for the preparation of phosphor bronze. The method of its manufacture is described in detail.

**A New Process for Separating Nickel and Copper.** By R. P. ROTHWELL. *Eng. Min. J.*, 63, 328.—N. V. Hybinette and A. R. Ledoux have tested, on a large scale, at the Balbach works, Newark, N. J., a new process for separating nickel and copper sulphides. It consists in smelting nickel-copper matte with oxide of manganese and cooling, when the mixture will separate into two parts, the "top" containing most of the copper and manganese sulphide, the "bottom" most of the nickel sulphide. By repeating the operation the separation becomes perfect. The manganese can be used over again (how is not stated) or a manganese bronze made of the top.

**Practical Treatment of Pyritic Gold Ores at Gibbonsville, Mont.** By C. C. BURGER. *Min. Sci. Press*, 74, 282-285.—This is a detailed description of the process in use, *viz.* : (1) Amalgamation in the battery and saving of concentrates; (2) roasting in twenty-four hours from 12 to 15 tons of concentrates with from 33 to 40 per cent. sulphur, in a two-hearth Pearce turret furnace, supplemented by a small hand reverberatory furnace holding two  $1\frac{1}{2}$ -ton charges, to insure dead-roasting without diminishing the capacity of the mechanical furnace; (3) Chlorinating in a  $1\frac{1}{2}$ -ton Thies barrel; (4) Filtering with compressed air in steel lead-lined cylinders swung on trunnions; (5) Settling any slimes that passed the filter cloth; (6) Precipitating with ferrous sulphate. The cost of chlorinating is less than \$5 per ton. The ore is low-grade (\$10 per ton), the gangue consists of quartz and magnesian slate, the concentrates are mainly pyrite, contain some arsenopyrite, and show from 0.5 to 1 per cent. copper.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

## REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOVES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

**Applications of the Cyanide Process in South Africa.** By C. BUTTERS. *Eng. Min. J.*, 63, 233-234.—This is a lecture delivered before the Chemistry Section of the Science Association of the University of California, Berkeley, Cal. It contains an account of the development of the process in South Africa, and gives the details of the present practice, which are of much interest to the metallurgist.

**Sodium Dioxide in Cyaniding Ores.** By J. H. BURFEIND. *Eng. Min. J.*, 63, 399-400.—The author does not accept the statement that in cyaniding ores containing alkali earth sulphates, the extraction of precious metal is increased, and the consumption of cyanide diminished, by the use of sodium dioxide. He believes that alkali earth sulphates are in part converted into cyanides, which are solvents for gold, and an equivalent amount of potash into sulphate. Taking, *e. g.*, an ore with gypsum, some of it will be converted into calcium cyanide. In dissolving gold, the double cyanide of gold and calcium will be formed in addition to the double cyanide of potassium and gold. If such a solution is treated with zinc shavings, the products will be gold, calcium and potassium hydroxides, zinc cyanide, and hydrogen; potassium hydroxide and zinc cyanide will combine to a soluble double salt, while from the calcium hydroxide there will be precipitated calcium carbonate by potassium carbonate in the solution and by carbonic acid taken up from the air. This explains the fact that the precipitated gold is often rich in calcium carbonate. While the formation of calcium carbonate can be avoided by the use of sodium dioxide, it is practically non-available on account of its cost, and the removal of

calcium carbonate from the gold precipitate is easy and costs next to nothing.

**Separation of Gold and Silver from Low-Grade Bullion.** By F. GUTZKOW. *Eng. Min. J.*, 63, 380-381.—The sulphuric acid process being suited only for high-grade doré silver, millmen ship their low-grade bullion, of say 500 thousandths fineness, to lead refineries where the copper is removed by cupelling with lead. This involves a great expense to the millman who pays for transportation of the copper in his bullion east, and of the blue vitriol west, in addition to a high refining charge based on the gross ounce of bullion. The process in question aims to separate silver, gold, and copper at the mill, producing fine silver, gold of greater or less purity, and blue vitriol. In the process the low-grade alloy is dissolved in a cast-iron vessel in sulphuric acid that is lighter than 66° Beaumé. When dissolved, heating is continued until the water is drawn off and the solution becomes so concentrated that anhydrous cupric sulphate is formed and separates. Now the clear silver solution is siphoned off, diluted and cooled, when silver sulphate crystallizes out and is treated in the usual way, while the mother-liquor of about 62° Beaumé is strengthened with fresh acid, and is ready to be used for a new charge. The gold and copper sulphates remaining with some silver sulphate and impurities in the iron vessel, are removed to a pan and boiled in water in the presence of some metallic copper, when the cupric sulphate will be hydrated and dissolved, and the silver sulphate decomposed. The blue vitriol solution is concentrated and crystallized, and the gold, contaminated with some silver and insoluble impurities, treated by one of the usual methods.

**Chemical Hints to Foundrymen.** By G. R. JOHNSON. *Foundry*, 10, 71-73; *Iron Age*, 59, No. 10, 5-8.—The paper is a study of the effect of carbon, silicon, sulphur, phosphorus, and manganese upon foundry iron. Many analyses of pig irons from the Embreville Iron Co., Embreville, Tenn., are brought together in tables, and the relations of chemical composition and physical properties shown.

**The Bertrand-Thiel Open Hearth Process.** By J. HARTSHORNE. *Iron Age*, 59, No. 12, 2-4.—This article contains a discussion of a paper read by P. C. Gilchrist, before the Cleveland (England) Institute of Engineers.

W. H. WALKER, REVIEWER.

**An Alloy Composed of Two-thirds Aluminum and One-third Zinc.** By W. F. DURAND. *Science*, 5, 396.—Of the alloys of zinc and aluminum, one having the above proportions gives the

best results, showing itself equal to good cast iron in strength, and superior in many other qualities. It melts at about 800° F., does not readily oxidize, takes a fine finish, and perfectly fills the smallest parts of a mould. Like cast iron, it is brittle, but it is recommended when lightness and strength, combined with good finish and resistance to corrosion, are among the desiderata.

## INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

**On Hydrocobaltocobalticyanic Acid and Its Salts.** By C. LORING JACKSON AND A. M. COMEY. *Am. Chem. J.*, 19, 271-281.—With the hope of preparing from potassium cobalticyanide compounds analogous to the nitroprussides, a strong solution of potassium cobalticyanide was boiled with strong nitric acid. In less than five minutes the liquid turned red, and the color increased in intensity as the boiling was continued. After boiling about two hours the red solution was converted into a semi-solid gelatinous mass. This product was purified by heating with more nitric acid and washing with water, but as the impurities were removed it began to pass into solution. Essentially all of the cobalt remained in the precipitate, and in the filtrate there was found nitric and hydrocyanic acids, and potassium nitrate. The insoluble jelly was dried *in vacuo* for analysis, when it changed in color from red to a grayish green, but was very hygroscopic, absorbing water readily, at the same time regaining its red color. The solubility seems to vary with the preparation. It usually dissolves slowly, and to a limited extent in cold water, but digestion at 60° C. brings it completely into solution. The composition corresponds to the formula  $\text{KH}_2\text{Co}_2(\text{CN})_{11}\cdot\text{H}_2\text{O}$ . The solution is strongly acid and gives colored precipitates with metallic salts. By mixing a solution of the salt with potassium acetate and alcohol, there is thrown down a pink, flocculent precipitate, which is the dipotassium cobaltocobalticyanide,  $\text{K}_2\text{HCo}_2(\text{CN})_{11}\cdot 2\text{H}_2\text{O}$ . Barium cobaltocobalticyanide,  $\text{BaHCo}_2(\text{CN})_{11}\cdot \frac{1}{2}\text{H}_2\text{O}$ , retains its water of crystallization at 180°C., and is decomposed at 225°C. The silver salt,  $\text{Ag}_2\text{Co}_2(\text{CN})_{11}\cdot\text{H}_2\text{O}$ , is made by adding an excess of silver nitrate to the solution of the monopotassium salt. The zinc salt,  $\text{ZnHCo}_2(\text{CN})_{11}\cdot 3\text{H}_2\text{O}$ , and copper salt,  $\text{Cu}_2[\text{Co}_2(\text{CN})_{11}]_2\cdot 4\text{H}_2\text{O}$ , are also described. Free hydrocobaltocobalticyanic acid was obtained by treating hydrocobalticyanic acid with nitric acid, precisely as was done with the potassium cobalticyanide in making the monopotassium salt, which it closely resembles, except that it is less stable and gives off hydrocyanic acid when dried. When potassium hydroxide was added to the solution of the monopotassium salt, it turned

dark brown in the cold, and when the liquid was warmed the color deepened to a black, but nothing was precipitated until the solution was boiled. A precipitate of cobaltic hydrate was then formed, but the separation was slow and gradual. If the solution is filtered before precipitation is complete, the yellowish filtrate gives a further precipitate of cobaltic hydroxide on boiling again. Acetic acid added to this solution does not set free hydrocyanic acid. If, after the acetic acid, alcohol be added, it throws out fine white needles, which, on analysis, are shown to be identical with potassium cobalticyanide, but of entirely different crystal habit. A secondary oily product was formed in this reaction, which, on drying, was converted into a yellow solid, the nature of which has not been established. There is a general analogy between these substances and Prussian blue, but they differ essentially, in that in the cobalt compounds all of the cobalt is in the basic portion of the salt.

**On the Analogies in Composition of the Salts of Calcium, Strontium, and Barium.** By J. H. KASTLE. *Am. Chem. J.*, 19, 281-290.—The author has found that of 280 acids described in chemical literature, 252 show analogies in the composition of their calcium, strontium, and barium salts. Of these acids, the calcium, strontium, and barium salts of 141 have been described. From this number, 34 salts are entirely analogous for the three elements, and 79 show analogies between two of the salts. Of the latter, the analogy existing between the calcium and strontium salts is shown in 30 instances, between the calcium and barium salts in 25, and between the strontium and barium salts in 30 cases. In addition, 139 acids have been found, of which the salt of only two of these metals have been described, but all are stated to be analogous. From these observations the author comes to the general conclusion that *of the calcium, strontium, and barium salts of any acid, all or two of the salts of these metals will be found to be analogous in composition.* This is in opposition to the statement of Lenssen, that there is closer relationship between the strontium and barium than the calcium salts.

**On the Action of Ammonia upon Cupriammonium Acetobromide.** By THEODORE WILLIAM RICHARDS AND ROBERT JAY FORSYTHE. *Proc. Am. Acad. Arts and Sci.*, 32, 239-241.—By passing ammonia gas over cupriammonium acetobromide in a glass tube, placed in a freezing mixture, the substance takes up ammonia corresponding in amount to  $3\text{NH}_3$ . The new substance,  $\text{CuBrC}_2\text{H}_4\text{O}_{2.5}\text{NH}_3$ , dissolves in water to a deep blue solution, and loses ammonia on exposure to the air passing over into a green compound,  $\text{CuBr}_{2.6}\text{NH}_3$ . This change of color is taken as proof that the ammonia decomposed the original cupri-

ammonium acetobromide, and the decomposition of the addition product may be represented in this way :



The first of these compounds was already known, and the second was synthesized by passing ammonia over cupriammonium acetate. The analytical data are not exact, owing both to the ease with which the substances lose ammonia, and to their great hygroscopic power.

**On Certain Double Halogen Salts of Caesium and Rubidium.**

By H. L. WELLS AND H. W. FOOTE. *Am. J. Sci.*, 153, 461-465.—The authors have repeated the work of Remsen and Saunders and Remsen and Brigham, to see whether, by working under widely varying conditions, they could obtain several simpler salts by recrystallizing the complex rubidium antimony chloride,  $2_3\text{RbCl} \cdot 1_0\text{SbCl}_3$ . No variation of composition was detected, although the salt was crystallized from dilute, concentrated and alcoholic hydrochloric acid. The analytical process used in the determination of antimony was checked against the pure salt,  $\text{Cs}_3\text{Sb}_2\text{Cl}_9$ , containing nearly the same percentage of antimony. The method gave results about 0.25 per cent. too high, and the authors believe that by subtracting this constant error from the amount of antimony found in the analyses of the rubidium salt, it will give results nearer the truth. The results thus obtained agree more closely with the simpler formula,  $7\text{RbCl} \cdot 3\text{SbCl}_3$ , and this formula is proposed for this salt as well as for the other salts of analogous composition, described by Remsen and Brigham, Herty, and Wheeler. While there is much to be said in favor of the simple formula, it would seem advisable to offer evidence as to the accuracy of the determination of rubidium and chlorine in the salts as well as antimony. In recrystallizing this complex rubidium antimony chloride from very dilute hydrochloric acid, just enough to prevent the precipitation of antimony oxychloride, a new salt having the composition  $2\text{RbCl} \cdot \text{SbCl}_3 \cdot \text{SbOCl}$  was formed. It crystallizes in sharp, colorless prisms, and can be recrystallized from dilute hydrochloric acid. The work of Remsen and Brigham on the caesium bismuth chlorides was confirmed, and the new salt,  $3\text{CsI} \cdot 2\text{BiI}_3$ , described. For analysis this salt was dissolved in dilute hydrochloric acid, the bismuth precipitated as sulphide, digested with nitric acid until decomposed, the free sulphur removed by filtration, and the bismuth reprecipitated as carbonate. The caesium was determined as sulphate.

**On the Double Fluorides of Zirconium with Lithium, Sodium, and Thallium.** By H. L. WELLS AND H. W. FOOTE. *Am. J. Sci.*, 153, 466-471.—It has been found by a comparison of the double

fluorides of zirconium with ammonia, potassium, and caesium, that the types of double salts formed varied with the molecular weights of the alkaline fluorides. A relatively large number of molecules of small molecular weight enter into combination, while those fluorides of higher molecular weight combine with more zirconium fluoride than the others. This was found to be true also in double fluorides of zirconium and lithium. Salts of the 4 : 1 and 2 : 1 type were prepared, but the 3 : 1 type could not be made. The following table shows the symmetrical gradation of types, according to the atomic weight of the alkali metals :

Type.	Lithium salts.	Potassium salt. (Marignac.)	Caesium salts.
4 : 1	4LiF.ZrF <sub>4</sub> . <sub>4</sub> H <sub>2</sub> O	.....	.....
3 : 1	.....	3KF.ZrF <sub>4</sub>	.....
2 : 1	2LiF.ZrF <sub>4</sub>	2KF.ZrF <sub>4</sub>	2CsF.ZrF <sub>4</sub>
1 : 1	.....	KF.ZrF <sub>4</sub>	CsF.ZrF <sub>4</sub> .H <sub>2</sub> O
2 : 3	.....	.....	2CsF. <sub>3</sub> ZrF <sub>4</sub> . <sub>2</sub> H <sub>2</sub> O

The double fluorides of sodium and thallium with zirconium fluoride do not form a symmetrical series which will fall into line with the known other salts. The salt 2NaF.ZrF<sub>4</sub> was prepared by bringing together two parts sodium fluoride with fourteen parts zirconium fluoride. The following double fluorides of thallium and zirconium were prepared : TlF.ZrF<sub>4</sub>.H<sub>2</sub>O, 5TlF.<sub>3</sub>ZrF<sub>4</sub>.H<sub>2</sub>O, and 3TlF.ZrF<sub>4</sub>. The first salt separates without water of crystallization if the solution is evaporated until crystals begin to form, and then cooled. Two of these thallic salts correspond to recognized types of alkali salts, while the 5 : 3 type is new.

**The Oxides of Tungsten.** By E. N. D. DESI. *J. Am. Chem. Soc.*, 19, 213-241.—By treating tungstic acid or metallic tungsten with sulphuric and sulphurous acids at various temperatures, under atmospheric pressure and in sealed tubes, oxides of tungsten were isolated corresponding to the formulas WO, W<sub>2</sub>O<sub>3</sub>, W<sub>3</sub>O<sub>5</sub>, W<sub>5</sub>O<sub>11</sub>, W<sub>7</sub>O<sub>19</sub>, W<sub>11</sub>O<sub>34</sub>. By heating ammonium tungstate to a white heat the oxide, W<sub>2</sub>O<sub>3</sub>, was formed, and it was also obtained by fusing tungstic acid with potassium iodide. Upon fusing tungstic acid with potassium chloride, potassium bromide, metallic sodium or potassium, metallic tungsten was formed. Different oxynitrides of tungsten were prepared by acting upon tungstic acid with ammonium chloride, potassium cyanide, and cyanogen. Tungstic acid can be separated from molybdic acid by dissolving the latter in sulphuric acid, while the former is entirely insoluble.

**Recovery of Waste Platinum Chloride.**—By H. W. WILEY. *J. Am. Chem. Soc.*, 19, 258-261.—Aluminum turnings are sug-

gested for the reduction of potassium platinochloride to metallic platinum.

**Compounds of Metallic Hydroxides with Iodine.** By THEODORE RETTIE. *J. Am. Chem. Soc.*, 19, 333-339.—The author has examined the brown precipitate formed when magnesium sulphate is treated with iodine and potassium hydroxide, and finds that it is not of constant composition, being principally magnesium hydroxide with a variable quantity of iodine. Colored precipitates are formed with zinc and cadmium salts. Glucinum sulphate, and calcium and strontium salts, give precipitates which dissolve on standing.

**Variations in the Composition of Red Lead.** By DURAND WOODMAN. *J. Am. Chem. Soc.*, 19, 339-341.—If commercial red lead is treated with a saturated solution of lead acetate the lead monoxide is dissolved, leaving the true red lead. The percentage of  $Pb_3O_4$  found in this way varies from 41 to 92 per cent.

## ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

**On the Colored Compounds Obtained from Sodic Ethylate and Certain Aromatic Nitro Compounds.** By C. LORING JACKSON AND MARTIN H. ITTNER. *Am. Chem. J.*, 19, 199-217.—By the action of sodium ethylate on fourteen compounds of the general structure  $CH_3$  (or  $COOH$ )<sub>(1)</sub>  $NO_2$ <sub>(3)</sub>  $X$ <sub>(4)</sub>  $NO_2$ <sub>(5)</sub> colored bodies analogous to those obtained by Victor Meyer (*Ber.*, 27, 3153) and Lobry de Bruyn (*Rec. Trav. Chim. Pays. Bas.*, 14, 89) from *s*-dinitrobenzoic acid and *s*-trinitrobenzene have been prepared. The colors formed from the toluene derivatives lasted but a few seconds, while those from the benzoic acids were stable for several hours. The colored compound from dinitranisic acid was isolated by precipitation from an alcoholic solution with ligroin and, after drying *in vacuo*, had the composition  $C_6H_5OCH_2NO_2NO_2COONa$ .  $C_6H_5ONa$ . When heated at 110° it was decomposed and lost a weight nearly corresponding to one molecule of alcohol. The authors offer no structural formulæ for the compounds, but show that the explanation of Victor Meyer, that they are formed by the replacement of one atom of hydrogen in the benzene ring by an atom of sodium, and the addition of a molecule of alcohol of crystallization is rendered improbable by the work of Lobry de Bruyn. The latter proved that *s*-trinitrobenzene is not acted on by sodium in boiling xylene and that its colored derivative has the composition  $C_6H_5(NO_2)_2CH_2OK \cdot \frac{1}{2}H_2O$ , in which, if Meyer's

explanation is correct, there are both alcohol and water of crystallization. This latter assumption is highly improbable.

**On the Action of Chlorcarbolic Ethyl Ester on Formanilide.** By H. L. WHEELER AND H. F. METCALF. *Am. Chem. J.*, 19, 217-227.—The authors have studied the action of chlorcarbolic ethyl ester on formanilide, and find that the explanations of the reaction given by Lellmann (*Ber.*, 14, 2512), and Freer and Sherman (*Am. Chem. J.*, 18, 579), are in part incorrect. The following substances were obtained as final reaction-products: Diphenylformamidine hydrochloride, formylphenylurethane, phenylurethane, carbon dioxide, carbon monoxide, and ethyl chloride. The reaction can be explained whether formanilide is, as its name implies, an anilide with the structure  $\text{HCO.NHC}_6\text{H}_5$ , or whether it has the imido structure and is phenylimidoformic acid. Its structure cannot, therefore, be determined by the final reaction-products. The oil obtained by Freer and Sherman (*loc. cit.*), and which they state is ethylisoformanilide, proved to be a mixture of formphenylurethane, phenylurethane, and unaltered formanilide. It is also shown that Claisen's argument (*Ann. Chem. (Liebig)*, 287, 360) for the amide structure of formanilide, based on the relation of its boiling-point and that of its oxygenester, is not well taken. Formylphenylurethane,  $\text{C}_6\text{H}_5\text{N.CO.CO.C}_6\text{H}_5$ , was prepared by the action of chlorcarbolic ethyl ester on ethylisoformanilide. It boils from 149° to 151° at 15 mm. pressure. The above structure was shown to be correct by the action of alkali and of phenyl hydrazine. With the former there was a separation of the lower acid, giving phenylurethane; with the latter,  $\alpha$ -formphenylhydrazine was formed.

**Naphthalene Tetrabromide,  $\text{C}_{10}\text{H}_8\text{Br}_4$ .** By W. R. ORNDORFF AND C. B. MOYER. *Am. Chem. J.*, 19, 262-270.—But one of the three possible stereochemical modifications of naphthalene tetrabromide was formed by the action of naphthalene on bromine. This was made by cautiously treating naphthalene covered with an ice-cold four per cent. solution of sodium hydroxide with bromine, and allowing the mixture to stand in the cold for several hours. Of the pure product, which melted at 111°, with decomposition after crystallization from chloroform, 7 grams were obtained from 100 grams of naphthalene. A large quantity of  $\alpha$ -monobromnaphthalene and 1:4 dibromnaphthalene were obtained at the same time. The tetrabromide is insoluble in water, ether, glacial acetic acid, and cold alcohol; soluble in hot water, carbon bisulphide, ligroin, hot chloroform, and hot benzene. It crystallizes in transparent monoclinic prisms, which become opaque on standing. A full crystallographic study of the compound is given. As the tetrabromide decomposed in

all boiling solvents, its molecular weight could not be determined. A determination of the molecular weight of the analogous chloride gave results corresponding to the formula  $C_{10}H_8Cl_4$ .

**Action of Mercaptides on Quinones.** By H. S. GRINDLEY AND J. L. SAMMIS. *Am. Chem. J.*, 19, 290-295.—By the action of sodium mercaptide on dichlorodiphenoxquinone, a compound was obtained analogous to the hemiacetals prepared by Jackson and Grindley (*Am. Chem. J.*, 17, 577) from quinones and sodium alcoholates. The yellow sodium salt formed when six molecules of the mercaptide and one of the quinone were used was so unstable that it could not be analyzed. It decomposed readily in the presence of water forming tetrathioethylquinone,  $C_6(SC_2H_5)_4O_2$ , which melts at  $90^{\circ}$ - $91^{\circ}$ , and gives a hydroquinone melting at  $58^{\circ}$ . The tetrathioethylquinone, when treated with two equivalents of sodium mercaptide, gives the unstable yellow salt which, in turn, gives the compound tetrathioethylquinone dibenzoyl-dithiobenzoylacetal  $C_6(S.C_2H_5)_4(O.CO.C_6H_5)_2(S.CO.C_6H_5)_2$ , when treated with benzoyl chloride in alcoholic solution. The substance is not affected by either zinc dust and glacial acetic acid or hydroxylamine hydrochloride.

**The Hydrolysis of Acid Amides.** By IRA REMSEN. *Am. Chem. J.*, 19, 319-322.—In a preliminary note which announces that the author has undertaken an extensive investigation of the speed of hydrolysis of the acid amides, the rate of decomposition of the three nitrobenzamides with half normal hydrochloric acid is reported. At the end of 3 hours 3.3 per cent. of the *o*-amide, 80.5 per cent. of the *m*-amide, and 84.5 per cent. of the *p*-amide were hydrolyzed. At the end of 6 hours 6.2 per cent., 94.2 per cent., and 96.9 per cent. of the ortho, meta, and para amides, respectively, were changed.

**On Urethanes.** By OTTO FOLIN. *Am. Chem. J.*, 19, 323-352.—From the study of the action of sodium methylate on a number of acid bromamides the author deduces the following conclusion: The reaction



is quite as general as the analogous reaction of alkalies on acid bromamides, and should be as useful in the preparation of urethanes, as is the reaction of Hofmann for the amines. The introduction of negative groups into the radical R does not prevent the "Beckmann rearrangement," and in no case was direct substitution of the bromine effected even to a slight extent. The introduction of a positive group in one case had no more influence than that of a negative group. The following compounds were prepared from the corresponding bromamides and are de-

scribed in detail: Methylphenyl carbamate; methyl-*m*-nitrophenyl carbamate, crystallizing in well-formed octahedra which melt at 147°-149°; methyl-*o*-nitrophenyl carbamate, greenish-yellow crystals, which melt at 53°; methyl-*m*-bromophenyl carbamate, white crystals melting at 84.5°-85.5°. The yield in all cases was nearly quantitative. As it was found impossible to obtain an acid bromamide containing the amido or dialkylamido group in the benzene ring, an analogous amide in the aliphatic series was prepared, carbomethoxy-β-amidopropionbromamide,  $\text{CH}_3\text{O}_2\text{CNHCH}_2\text{CH}_2\text{CONHBr}$ , from which the corresponding urethane was formed by the action of sodium methylate. The study of the action of phosphorus pentachloride on a number of aromatic urethanes leads to the following equation, which is general.



This reaction and the one given above furnish easy methods for the preparation of chlorformanilides and isocyanates. With free urethane phosphorus pentachloride splits off ethyl chloride and a carbamide chloride is formed, but the reaction is not so simple as with the aromatic urethanes. A simple method of preparation of urethane from potassium cyanate and alcohol is described. Phosgene and urethane, when brought together in molecular proportions, reacted simultaneously in the different ways:

1.  $\text{NH}_2\text{CO}_2\text{C}_2\text{H}_5 + \text{COCl} = \text{CICONHCO}_2\text{C}_2\text{H}_5 + \text{HCl}$ .
2.  $\text{CICONHCO}_2\text{C}_2\text{H}_5 + \text{NH}_2\text{CO}_2\text{C}_2\text{H}_5 = \text{CO}(\text{NHCO}_2\text{C}_2\text{H}_5)_2 + \text{HCl}$ .
3.  $2\text{NH}_2\text{CO}_2\text{C}_2\text{H}_5 + \text{COCl} = \text{NH}_2\text{CONHCO}_2\text{C}_2\text{H}_5 + \text{C}_2\text{H}_5\text{Cl} + \text{CO}_2 + \text{HCl}$ .

The products of the reaction are fully described.

#### Action of Phosphorus Pentachloride on Aniline and its Salts.

By J. ELLIOTT GILPIN. *Am. Chem. J.*, 19, 352-363.—Trichlorophosphanil,  $\text{PCl}_3(\text{NC}_6\text{H}_5)$ , was obtained by subliming phosphorus pentachloride and aniline hydrochloride at 170° for six hours. The compound condensed in the cooler part of the vessel as a white coating. It cannot be purified by crystallization, as all solvents decompose it. Concentrated sulphuric acid, alcohol, and ether, cause an evolution of hydrochloric acid; sodium hydroxide changes it to a hard, brittle mass; and water decomposes it into aniline hydrochloride and phosphoric acid. Neither the sulphate nor the nitrate of aniline gave the compound when heated with phosphorus pentachloride. Aniline and phosphorus pentachloride react readily with evolution of hydrochloric acid. The cooled mass is extracted with water,

then with small portions of hot alcohol, until, on evaporation, one kind of crystals is obtained, and finally crystallized from boiling alcohol. The resulting compound, chlorphostetranilide,  $\text{PCl}(\text{NHC}_6\text{H}_4)_4$ , is very stable. It is not decomposed when boiled with water, concentrated alkali, or hydrochloric acid; but when heated with water in a sealed tube at  $180^\circ$ , aniline, aniline hydrochloride, and phosphoric acid are formed. Only a small amount was decomposed when heated in a porcelain tube in a current of oxygen over the blast-lamp for several hours. A compound of the structure  $\text{P}(\text{OH})(\text{NHC}_6\text{H}_4\text{SO}_3\text{H})_4$ , was formed by the action of concentrated sulphuric acid on chlorphostetranilide. Acid lead and barium salts were formed by the replacement of six hydrogen atoms in two molecules of the acid. The three toluidines reacted with phosphorus pentachloride and formed compounds of analogous composition.

**On the Preparation of Metabrombenzoic Acid and of Metabromnitrobenzene.** By H. L. WHEELER AND B. W. MCFARLAND. *Am. Chem. J.*, 19, 363-367.—The authors offer the following much improved method for the preparation of metabrombenzoic acid: 20 grams of benzoic acid and 6 grams of iron wire are heated in a flask, connected with a return condenser, to  $170^\circ$ , when 48 grams of bromine are added, drop by drop, while the temperature of the bath is allowed to rise slowly to  $260^\circ$ . After purification and distillation, 20 grams of the pure acid were obtained. Perbrombenzene,  $\text{C}_6\text{Br}_5$ , was formed when 5 grams of benzoic acid, 2 grams of iron, and 37.4 grams of bromine were heated in a tube to  $225^\circ$  for 5 hours. Metabromnitrobenzene was prepared as follows: 30 grams of nitrobenzene and 3 grams of iron were heated to  $120^\circ$ , when 60 grams of bromine were added gradually. A 75 per cent. yield was obtained. Paradichlorbenzene reacts readily with bromine in the presence of iron, giving probably 1,4-dichlor-2,5-dibrombenzene, which melts at  $148^\circ$ .

**On the Non-Existence of Four Methenylphenylparatolylamidines.** By H. L. WHEELER. *Am. Chem. J.*, 19, 367-374.—Walther (*J. prakt. Chem.*, 55, 41) has described the preparation of four isomeric methenylphenylparatolylamidines. The author has examined the various methods carefully, and comes to the conclusion that they all give the same body, which melts at  $103^\circ.5$ - $104^\circ.5$ .

**The Action of Certain Alcohols on Asym-Metadiazoxylene-sulphonic Acid.** By W. B. SHOBER AND H. E. KIEFER. *Am. Chem. J.*, 19, 381-393.— $\alpha$ -metaxylidinesulphonic acid, prepared by the method of Jacobson and Ledderboge (*Ber.*, 16, 193), was diazotized with nitrous fumes. The yield of the diazo com-

pound was 94 per cent. of the theoretical amount. Different portions of the diazo compound were decomposed with methyl, ethyl, and propyl alcohols under varying pressures. In all cases both the hydrogen and the alkoxy reaction took place, the latter to a much larger extent, which increased with increased pressure. *a*-metamethoxyxylene sulphonic acid crystallizes from benzene in needles, and forms potassium, barium, copper, zinc, and sodium salts. Its amide melts at 190°. *a*-propoxoxyxylene sulphonic acid crystallizes from alcohol in needles, and forms well characterized barium, potassium, and zinc salts. Its amide melts at 146°. By the oxidation of *a*-metamethoxyxylene sulphonamide, an acid of the probable structure  $C_6H_5CH_2(1)COOH(3)OCH_2(4)SO_3NH_2(6)+H_2O$  was obtained. The barium and calcium salts were prepared, but did not crystallize well.

**The Preparation of Zinc Ethyl.** By ARTHUR LACHMAN. *Am. Chem. J.*, 19, 410-411.—By using an improved zinc-copper couple in the preparation of zinc ethyl by the process of Gladstone and Tribe (*J. Chem. Soc.*, 1879, 570), the author obtained a yield of 70-90 per cent. in half the time required by the old method. The couple is prepared by passing a stream of hydrogen for 20 minutes over a mixture of 100 parts of zinc dust and 12 parts of copper oxide heated to redness in a combustion tube.

**A Simple Test for the Halogens in Organic Halides.** By J. H. KASTLE AND W. A. BEATTY. *Am. Chem. J.*, 19, 412-413.—To test for halogens in non-volatile substances about 1 gram is heated with 5 grams of a mixture of equal weights of copper nitrate and silver nitrate until the latter are reduced to oxides. The resulting mixture is treated with a little water, dilutesulphuric acid, and zinc for 5 minutes, filtered, and tested for halogen with silver nitrate. Volatile substances are heated in an S-shaped tube closed at one end, and the vapors passed over a mixture of the nitrates heated to redness. The method was tested with a large number of substances and was successful in every case.

**Notes on Caffein.** By G. L. SPENCER. *J. Am. Chem. Soc.*, 19, 279-281.—The author compares a gravimetric method for the estimation of caffein proposed by himself (*J. Anal. Chem.*, 4, 390) with the volumetric method of Gomberg (*J. Am. Chem. Soc.*, 18, 331), and finds that both give the same result. The volumetric method is to be preferred on account of its wider applicability.

**Periodides of Pyridine.** By P. F. TROWBRIDGE. *J. Am. Chem. Soc.*, 19, 322-331.—From a series of experiments on the formation of periodides of pyridine methyl iodide, the author

concludes that at ordinary temperatures and with small amounts of iodine, the triiodide is usually formed, and with larger amounts of iodine the pentiodide. When hot saturated solutions were used a heptiodide resulted. Two forms of pyridine hydroiodide are described,  $C_6H_5N\cdot HI$  and  $C_6H_5N\cdot HI\cdot H_2O$ , and periodides containing two, five, and seven iodine atoms. A molecular weight determination in phenol of the unusual periodide containing two atoms of iodine showed that its formula is  $C_6H_5N\cdot HI\cdot I$ .

**Modification of the Thallequin Test for Quinine.** By F. S. HYDE. *J. Am. Chem. Soc.*, 19, 331-332.—It is recommended that very dilute solutions be used in the above test, and a filtered solution of calcium hypochlorite instead of chlorine or bromine water.

G. W. ROLFE, REVIEWER.

**Allotropy of Sucrose.** By F. G. WIECHMANN. *J. Phys. Chem.*, 1, 69-74.—The paper records a series of experiments made by the author on an amorphous modification of cane sugar, made by rapidly heating the sugar to boiling, covering the vessel and boiling ten minutes, raising the solution to  $176^{\circ}$  C., the mass then being rapidly cooled by pouring it on a copper slab. The results point to the conclusion that very minute traces of dissolved inorganic matter tend to cause the sugar to revert to the crystalline form, while, if the sugar is absolutely pure, the amorphous state persists indefinitely.

## GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

A. H. GILL, REVIEWER.

**On the Butanes and Octanes in American (Ohio) Petroleum.** By C. F. MABERY AND E. T. HUDSON. *Proc. Am. Acad. Arts and Sci.*, 32, 101-118; *Am. Chem. J.*, 19, 243-262.—Hitherto it has been assumed that the butane in petroleum was the normal compound; but the results of this investigation show it to be isobutane, and that its boiling-point is  $0^{\circ}$  instead of  $-17^{\circ}$ ; iso-pentane of boiling-point  $29^{\circ}-30^{\circ}$  was also present. Two octanes were obtained, having a boiling-point of  $119.5^{\circ}$  and  $124^{\circ}-125^{\circ}$ , respectively, and specific gravities at  $20^{\circ}$  of 0.7243 and 0.7134, respectively. The latter is assumed to be the normal compound, but enough could not be obtained to determine its composition. Diisobutyl could not be detected. Attention is called to the fact that the specific gravity of hydrocarbons from this source is greater than that of the same hydrocarbons synthetically prepared, owing probably to the presence of naphthenes.

**The Constituents of Pennsylvania, Ohio, and Canadian Petroleum between 150° and 220°.** By C. F. MABERY. *Proc. Am. Acad. Arts and Sci.*, 32, 121-176.—The author calls attention to the conflicting statements regarding the constituents of the fractions of American petroleums boiling between 150° and 220°. Some believe them to be naphthenes, while others, on the basis of Pelouze and Cahours' work, consider that they are members of the fatty series; the author's opinion that the higher portions belonged to the  $C_nH_{2n}$  series was not sustained. The separation of these bodies presents greater difficulties than those of the lighter portions, as they must be fractionated *in vacuo*. As it was found that cracking did not begin with the Pennsylvania oils until a temperature above 225° was reached, refinery distillates of a gravity of 48°-50° Baumé were used as the initial material. These were fractionated many times—mention is made of forty-five and fifty distillations—and the distillates treated in some cases with fuming sulphuric acid to remove mesitylene. The Ohio and Canadian distillates were obtained from the crude oils by distillation *in vacuo*. The Pennsylvania petroleum contains a decane of b. pt. 163°-164° and sp. gr. 0.7684, another decane, probably the normal, of b. pt. 173°-174°, sp. gr. 0.7486, an hendecane of b. pt. 186°-197°, sp. gr. 0.7662, and a dodecane of b. pt. 214°-216°, sp. gr. 0.7684. Mesitylene, cumol, pseudocumol, cymol, isocymol, durol, isodurol are probably present in small quantities. Ohio Trenton petroleum, within the same limits, contains the same members; the higher specific gravity of the distillates being caused by a larger proportion of aromatic hydrocarbons. The fractions of Canadian corniferous petroleum from Petrolica, boiling between 163° and 173° contain the same constituents. The hydrocarbons collecting between 196° and 214° are of the  $C_nH_{2n}$  series. The proportion of aromatic hydrocarbons is greater in Canadian than in Ohio petroleum.

**Refractive Power of the Hydrocarbons and Chlorine Derivatives Described in the Preceding Paper.** By C. F. MABERY AND E. T. HUDSON. *Proc. Am. Acad. Arts and Sci.*, 32, 179-182.—A comparison of the compounds from Pennsylvania petroleum shows a lower refractive index than the same compound from Ohio and Canadian petroleum, as well as a lower specific gravity. The effect of the second chlorine atom in raising the refractive index is also well illustrated.

**On the Composition of a South American Petroleum.** By C. F. MABERY AND A. S. KITTELBERGER. *Proc. Am. Acad. Arts and Sci.*, 32, 185-191; *Am. Chem. J.*, 19, 374-381.—The oil came from the Magdalena river, in the United States of Columbia, and was dark and thick, and of 0.948 sp. gr. at 20°. It contained a small quantity of sulphur and was peculiar in the

instability of its least volatile portions, that boiling from  $310^{\circ}$ - $345^{\circ}$  cracking badly on distillation. It may contain naphthenes and possibly some of the benzene series. It resembles the Russian oils.

W. O. CROSBY, REVIEWER.

**A Relatively Acid Dike in the Connecticut Triassic Area.** By EDWARD OTIS HOVEY. *Am. J. Sci.*, 153, 287-292.—One of the striking features of the Triassic igneous rocks of the Atlantic border, from Nova Scotia to North Carolina, is their uniformity in appearance and in mineralogical and chemical composition. The only previously noted variations from the monotony of the diabase traps have been rocks of slightly more basic character. But the author has discovered in the Triassic strata near New Haven, and in intimate association with dikes of the normal diabase, two small dikes of distinctly more acid character. One complete analysis ( $\text{SiO}_2 = 60.13$ ) is given, and an analysis of the normal Triassic diabase ( $\text{SiO}_2 = 51.78$ ) is quoted for comparison. The composition of the new rock indicates that it belongs to the group of keratophyres.

**The Granitic Rocks of the Pyramid Peak District, Sierra Nevada, California.** By WALDEMAR LINDGREN. *Am. J. Sci.*, 153, 301-314.—The granitic rocks include granitite, granodiorite, and diorite. The granodiorite is an intermediate or transition type, and the diorite varies in the other direction to augite porphyrite. Complete bulk analyses of the granitite and granodiorite are given, and partial analyses of both these and the other types. From these analyses the proportions of the component minerals are calculated, the potash, soda, and lime feldspars being distinguished. The paper closes with a brief discussion of the general relations and succession of the rocks, which leaves much to be desired as regards the definiteness of the conclusions stated.

**On Roeblingite, a New Silicate from Franklin Furnace, N. J., Containing Sulphur Dioxide and Lead.** By S. L. PENFIELD AND H. W. FOOTE. *Am. J. Sci.*, 153, 413-415.—This new species, from a depth of a thousand feet in the great deposit of zinc ores at Franklin Furnace, is of peculiar interest, from the facts that silicates containing lead are very rare, and that this is the first time that a sulphite has been observed in nature. Although the mineral occurs in dense, white, compact masses, it is definitely known that it cannot be a mixture. The average of two very accordant analyses is:  $\text{SiO}_2$ , 23.58;  $\text{SO}_2$ , 9.00;  $\text{PbO}$ , 31.03;  $\text{MnO}$ , 2.48;  $\text{CaO}$ , 25.95;  $\text{SrO}$ , 1.40;  $\text{K}_2\text{O}$ , 0.13;  $\text{Na}_2\text{O}$ , 0.40;  $\text{H}_2\text{O}$ , 6.35 = 100.32 per cent. The nearest approach to a simple ratio is believed to be  $\text{SiO}_2 : \text{SO}_2 : \text{PbO} : \text{RO} :$

$\text{H}_2\text{O} = 5 : 2 : 2 : 7 : 5$ , giving the rather complicated formula  $\text{H}_{10}\text{Ca}_2\text{Pb}_2\text{Si}_6\text{S}_2\text{O}_{28}$ . The water is driven off at a rather high temperature and is therefore regarded as hydroxyl.

**Bacteria and the Decomposition of Rocks.** By JOHN C. BRANNER. *Am. J. Sci.*, 153, 438-442.—The author reviews the various published statements concerning the occurrence of bacteria in rocks and soils and their influence upon the decay of rocks, and finds the following conclusions to be more or less probable. The bacteria found in decayed rocks are chiefly the nitrifying forms, which reduce nitrogenous matter to nitric acid. These are not absolutely dependent upon organic food; that is, they may live in wholly inorganic media, but, in common with all bacteria, they require carbon and nitrogen. They are incapable of separating these elements from the air or water, but can obtain them only from organic bodies and certain salts which occur but rarely, if at all, in ordinary rock formations. Living bacteria are, therefore, practically limited to points near the surface, and to the decayed rocks; they cannot, then, be a primary or important cause of rock decay.

**On Wellsite, a New Mineral.** By J. H. PRATT AND H. W. FOOTE. *Am. J. Sci.*, 153, 443-448.—This new species occurs in the Buck Creek Corundum Mine, Clay County, N. C., intimately associated with corundum, albite, and hornblende. The crystallographic and physical features of the mineral show it to be closely related to the phillipsite and harmotome group of zeolites, and this view is fully corroborated by the chemical composition. The average of the two accordant analyses gives:  $\text{SiO}_4$ , 43.86;  $\text{Al}_2\text{O}_3$ , 24.96;  $\text{BaO}$ , 5.07;  $\text{SrO}$ , 1.15;  $\text{CaO}$ , 5.80;  $\text{MgO}$ , 0.62;  $\text{K}_2\text{O}$ , 3.40;  $\text{Na}_2\text{O}$ , 1.80;  $\text{H}_2\text{O}$ , 13.35 = 100.01. The ratio of  $\text{SiO}_4$  :  $\text{Al}_2\text{O}_3$  : RO (alkalies and earths) :  $\text{H}_2\text{O}$  is approximately 3 : 1 : 1 : 3, giving the formula  $R''\text{Al}_2\text{Si}_4\text{O}_{10} \cdot 3\text{H}_2\text{O}$ . Only one molecule of water is given off below 200° C., and regarding this alone as water of crystallization leads to the formula  $H_4R''\text{Al}_2\text{Si}_4\text{O}_{10} \cdot H_2\text{O}$ . A comparison with the other minerals of the phillipsite group, places it at the beginning of the series:

Wellsite.....	$\text{RAI}_2\text{Si}_4\text{O}_{10} \cdot 3\text{H}_2\text{O}$ .
Phillipsite.....	$\text{RAI}_2\text{Si}_4\text{O}_{10} \cdot 4\frac{1}{2}\text{H}_2\text{O}$ .
Harmotome .....	$\text{RAI}_2\text{Si}_4\text{O}_{10} \cdot 5\text{H}_2\text{O}$ .
Stilbite .....	$\text{RAI}_2\text{Si}_6\text{O}_{16} \cdot 6\text{H}_2\text{O}$ .

The analyses of phillipsite vary considerably, and the authors regard 4 : 4 as the most probable normal ratio of  $\text{SiO}_4$  :  $\text{H}_2\text{O}$ . The minerals then form a regular series in which this ratio is constantly unity. The relations of these minerals to the feld-spar are discussed, and the discovery of another member of the series with the  $\text{SiO}_4$  :  $\text{H}_2\text{O} = 2 : 2$ , is predicted.

**Italian Petrological Sketches, IV. The Rocca Monfina Region.**

By HENRY S. WASHINGTON. *J. Geol.*, 5, 241-256.—Rocca Monfina is another one of the extinct and composite Italian volcanoes, but in comparison with those previously described by this author, the order of succession of the lavas is reversed: (1), the leucitic, the oldest, which is subdivided into two sub-phases characterized by leucitites and leucite tephrites; (2), the trachytic; (3), the basaltic, which is the youngest. This is also the order of abundance, the leucitic lavas largely predominating. The petrographic descriptions are in several instances accompanied by chemical analyses. These include: (1) leucite tephrite, of which a widely different analysis by vom Rath is also quoted, the two agreeing closely only in the alumina and soda; and (2), biotite vulsinite, a trachytic rock of which two other analyses are quoted for comparison.

**The Bauxite Deposits of Arkansas.** By J. C. BRANNER. *J. Geol.*, 5, 263-289.—This is a full and systematic account of these deposits, which are of great extent, and have a large prospective value. Under the head of composition are given, first, four analyses of ferruginous bauxite, the percentage of iron ranging from 54.2 to 66.83, showing that the bauxites grade into impure iron ores. Two analyses of siliceous bauxite are then compared with an analysis of typical kaolin, to show that kaolin is practically another limit of variation. Finally ten analyses of Arkansas, and three of foreign bauxites are given in tabular form for comparison, the purest Arkansas sample yielding  $\text{SiO}_2$ , 2.00, and  $\text{Fe}_2\text{O}_3$ , 1.66 per cent. The origin of the bauxite deposits is discussed at some length, the author's view being that they are genetically connected with the eruptive syenite of that region.

**Hornblende Basalt in Northern California.** By J. S. DILLER. *Am. Geol.*, 19, 253-255.—This is a study of a water-worn cobble stone, the rock not having been found in place. A complete analysis by L. G. Eakins is given, and three other analyses of hornblende-basalts are quoted for comparison.

**On the Genesis of Clay Stones.** By H. W. NICHOLS. *Am. Geol.*, 19, 324-329.—This paper is an application of the modern theories of saturated solutions, to the problem of the clay stone the segregation of mineral substances in the rocks being in general a passage from a more soluble to a less soluble form. Calcium carbonate, for example, changes from aragonite to calcite in the formation of clay stones.

**The Anorthosites of the Rainy Lake Region.** By A. P. COLEMAN. *Can. Record Sci.*, 7, 230-235.—Reprinted from *J. Geol.*. See this Rev., 3, No. 4.

**On the Chemical Composition of Some Kansas Gypsum Rocks.** By E. H. S. BAILEY AND W. M. WHITTEN. *Kan. Univ. Quart.*, 6, 29-34.—Twelve analyses of gypsum from four different counties are given, and the proportions of the various constituents as they probably exist in the rock are calculated from each analysis. These show that the material is in the main of a high degree of purity, the majority of the analyses closely approximating the theoretical composition of gypsum. The chief impurities are the calcium and magnesium carbonates.

**The Leucite Hills of Wyoming.** By J. F. KEMP. *Bull. Geol. Soc. Am.*, 8, 169-182.—The Leucite Hills, situated in southwestern Wyoming, are surface flows of a highly vesicular leucitic lava. Two analyses are given, one original, and the other quoted from Zirkel, and seven analyses of the leucitic rocks from other regions are also quoted for comparison. The author concludes from the composition and the petrographic features that the rock is best described as leucite phonolite, which shades into leucitites and related types.

**Diabase Pitchstone and Mud Enclosures of the Triassic Trap of New England.** By B. K. EMERSON. *Bull. Geol. Soc. Am.*, 8, 59-86.—The absorption of large volumes of water and mud by the submarine lava flows has caused the mass to cool as a spherulitic glass, with a minute crackling, which gives it a pitchy luster and a large content of water (4.72 per cent.), thus forming a basic pitchstone, which does not seem to have been described before. A single very complete analysis of the pitchstone, by H. N. Stokes, is given, and this shows that the rock is somewhat more basic ( $\text{SiO}_2 = 46.86$  per cent.) than the normal diabase.

**Solution of Silica Under Atmospheric Conditions.** By C. WILLARD HAYES. *Bull. Geol. Soc. Am.*, 8, 213-220.—The author states that while it is doubtless true that, considered in its relations to other rock-forming minerals, quartz is one of the most insoluble, some recent observations show that under certain conditions now existing at the earth's surface, quartz is by no means proof against chemical, as well as mechanical, agents of erosion. Various observed cases of the solution of silica are then described, including geodes and quartzose conglomerates and sandstones; and it is attributed to the agency of the humic acids. By the oxidation of the vegetable tissues in the process of decay the humic acids are formed, chiefly humic and crenic. These absorb varying quantities of free nitrogen from the air forming the azo-humic acids, which in turn combine with free silica. The resulting complex acids combine with alkaline car-

bonates, particularly potassium carbonate, to form easily soluble salts. The author regards the presence of potassium carbonate as probably an essential factor in the process. Thenard has shown that the amount of silica dissolved by azo-humic acid is proportional to the content of nitrogen, varying from 7 to 24 per cent.

**Erosion at Base-level.** By MARIUS R. CAMPBELL. *Bull. Geol. Soc. Am.*, 8, 221-226.—This paper supplements the preceding one, being an attempt to apply the principle that silica and aluminous silicates (quartz and clay) are readily soluble in swamp waters, in explaining the sharp line of demarcation observed in many Appalachian valleys between the base-leveled bottoms and the lateral slopes.

**"Mineral Soap."** By W. C. KNIGHT. *Eng. Min. J.*, 63, 600-601.—This mineral, which it is proposed to call Taylorite, occurs in the Fort Benton shales of southwestern Wyoming. It is a soft, unctuous clay, with a marked soapy feeling in water, and is associated with gypsum and mirabilite. Four analyses are given, which show it to be essentially a siliceous kaolin, the chief impurities other than silica being ferric oxide and magnesia.

**Analysis of a Variety of Ilmenite.** By GEORGE M. PEEK. *Am. Chem. J.*, 19, 232.—The material analyzed is from Bedford County, Virginia. It yielded :  $\text{TiO}_2$ , 63.31;  $\text{FeO}$ , 35.99;  $\text{MgO}$ , 0.82;  $\text{SiO}_2$ , 1.25 = 101.37. This composition affords approximately the formula  $\text{Fe}_2\text{Ti}_2\text{O}_8$ , which lies between that of typical ilmenite ( $\text{Fe}_2\text{Ti}_2\text{O}_8$ ) and that of iserite ( $\text{Fe}_2\text{Ti}_4\text{O}_{10}$ ).

**"Mineral Tallow" from Danby, Vermont.** By L. E. SMOOTH. *Am. Chem. J.*, 19, 233.—This peculiar substance forms a layer two to three inches thick on the walls of a limestone cavern. It is of a soft, smooth, putty-like consistency, and entirely devoid of crystalline structure. Analysis gave 85.38 per cent. of water; and the dried material yielded :  $\text{CaO}$ , 52.19;  $\text{MgO}$ , 0.27;  $\text{CO}_2$ , 41.31;  $\text{SiO}_2$ , 3.57; org. mat. (by diff.), 2.66; nitrogen, 0.053 = 100.00. The organic matter, which forms about the same proportion as in an oyster shell, is regarded as an essential part of the deposit, the conclusion being that this large amount of calcium carbonate has been secreted by some minute form of life.

**Analysis of Dolomitic Marble from Texas, Md.** By GEORGE C. BUCK. *Am. Chem. J.*, 19, 234.—The analysis shows that this valuable marble approximates fairly to a true dolomite.

**Analysis of an Alum Water from Lee Co., Va.** By L. E. SMOOT. *Am. Chem. J.*, 19, 234-235.—This water has a strong alum taste, and yielded 3.715 grams per liter of aluminum, iron, and sodium sulphates, the first largely predominating.

**Analyses of Infusorial Earth.** By F. W. SMITHER. *Am. Chem. J.*, 19, 235-236.—Three samples were analyzed, from Richmond and King George Cos., Va., and Calvert Co., Md. The second is of exceptional purity, containing 65.83 per cent. of amorphous silica. The chief impurities are quartz and clay, with only traces of lime and magnesia.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

## REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.  
REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### ANALYTICAL CHEMISTRY.

#### ULTIMATE ANALYSIS.

W. H. WALKER, REVIEWER.

**The Complete Analysis of Chrome Ore.** By A. G. MCKENNA. *Proc. Eng. Soc. Western Pa.*, 63, 180-182.—The dried sample is fused in a nickel crucible (platinum is very easily attacked by this reagent) with an excess of sodium peroxide for a few minutes. This ensures complete decomposition of the ore, after which the sodium chromate formed is dissolved and determined volumetrically with a standard solution of a ferrous salt. The other constituents of the ore are separated and determined by the usual quantitative methods.

#### PROXIMATE ANALYSIS.

G. W. ROLFE, REVIEWER.

**A Recalculation of Wein's Table of Starch Equivalent to Copper Found Based on the Factor 0.92.** By WILLIAM H. KRUG. *J. Am. Chem. Soc.*, 19, 452.—This factor, 0.92, is that suggested by Wiley as the mean between Nägeli's, 0.918, and 0.925 of Ost.

**An Analytical Investigation of the Hydrolysis of Starch by Acids.** By G. W. ROLFE AND GEO. DEFREN. *Tech. Quart.*, 10, 133-166.—A revision of an earlier article in the same journal.

**The Determination of Reducing Sugars in Terms of Cupric Oxide.** By GEO. DEFREN. *Tech. Quart.*, 10, 167-182.—A revision of an earlier paper.

**Improved Method for the Determination of the Specific Gravity of Molasses.** By J. C. BOOT. *La. Planter and Sugar*

*Mfr.*, 18, 415.—The author suggests a modification of Sider-sky's method (*Ztschr. für Rübenzucker Indus.*, 1881, 192) in which a potassium carbonate solution of approximately the same specific gravity as the molasses is used to dilute the latter to the required volume. This obviates the necessity of determining the exact volume of the molasses itself by a separate weighing. The author shows that the error introduced under ordinary conditions is not over one one-thousandth.

F. H. THORP, REVIEWER.

**Method of Drying Sensitive Organic Substances.** By C. C. PARSONS. *J. Am. Chem. Soc.*, 19, 388.—The moisture in such substances as soap, wood pulp, and the like, may be determined by dividing the material into small, thin pieces and introducing these directly into a known weight of paraffine oil, which has been heated for some time to 250° C., before using. The mixture is put into a hot closet at 240° C., for a few minutes, and then weighed. The loss is called moisture. The operation seldom requires more than twenty minutes, and no decomposition of the substance takes place under the oil.

W. R. WHITNEY, REVIEWER.

**Riegler's Method for Estimating Sugar in Urine.** By HENRY C. C. MAISCH. *Am. J. Pharm.*, 69, 294–296.—The author gives reasons for his adverse criticism of the method for the determination of sugar in urine by means of Fehling solution, pointing out the fact, confirmed by his own experimental investigation, that other reducing bodies than sugars may, by their presence, introduce errors. He recommends the method of Rüben-ner, or Penzoldt's modification. This is a colorimetric test, the sugar being estimated by the depth of color in the precipitate which ammonia produces in the urine after it has been treated with lead acetate solution, and filtered.

**Notes on Opium Assaying.** By FRANK X. MOERK. *Am. J. Pharm.*, 69, 343–350.—These notes are valuable additions to the methods for the assaying of opium. The author recognizes the imperfections of all existing methods, and points to the need of more exact processes. Tables are given showing some results and exhibiting variations which are inconsistent with perfect methods, but which make evident the comparative value of the lime-water method.

**Analytical Processes and Laboratory Notes.** By CHAS. LA-WALL. *Am. J. Pharm.*, 69, 350–352.—Directions for a rapid and accurate method for the determination of caffeine in kola, guarana,

coffee, etc., are given. The material is treated with dilute ammonia and shaken out with chloroform. The filtered solution, on evaporation, leaves the fat and alkaloid, from which the fat is extracted with ether and the dried residue weighed. A note concerning the estimation of alkaloids in white hellebore follows, and the article concludes with a discussion of the purity of so-called "C. P." chemicals. The reviewer cannot agree with the author in his opinion concerning the use of "C. P.," and would deprecate the advancement of the idea that the "U. S. P." requirements represent a higher degree of purity than our older well-known "C. P." should. The mark "C. P." ought to indicate such a degree of purity of a preparation that present chemical methods can show no appreciable impurity, and the consequent and necessarily infrequent use of the term "chemically pure" should then be an evidence of its strict propriety.

**The Estimation of Menthol in Oil of Peppermint.** By CLEMENS KLEBER. *Pharm. Rev.*, 15, 135.—This paper presents a brief comparison of the author's method for the determination of menthol with that of Kebler, and concludes with a rapid, approximate method, in which a comparison is made of the titration value (in terms of sodium hydrate) of a definite quantity of acetic anhydride with the value of the same quantity after boiling 30 minutes with the oil containing menthol.

## TECHNICAL CHEMISTRY.

F. H. THORP, REVIEWER.

**Artificial Silk in Germany.** By GEORGE SAWTER. *U. S. Consular Rep.*, 54, 107-110.—The paper gives a brief description of the Lehner process for the production of artificial silk from wood pulp (see *U. S. Consular Rep.*, 48, 266), and also of the Seyfert process for its production from cotton yarn. The cotton is treated with a cold solution of caustic soda of 30° Bé., and then dried on a stretcher reel, under strong tension. The yarn is afterwards thoroughly washed, and dyed. The new artificial silk is very strong, non-inflammable, and it is claimed that washing does not injure its lustre.

**Quebracho Tanning in Uruguay.** By EDGAR SCHRAMM. *U. S. Consular Rep.*, 53, 495.—The advantages of quebracho wood as a tanning material and as lumber, are well presented. For use in tanning, the entire log is chipped up to a coarse sawdust and leached in much the same manner that oak bark is treated. It is claimed to be richer in tannins than oak bark.

**Photography in Natural Colors.** By FRANK H. MASON. *U. S. Consular Rep.*, 53, 518-521.—This is a popular account of

a new process, invented by M. Chassagne. An ordinary dry plate is treated with an unnamed colorless solution, and then exposed, developed, and fixed in the usual manner, producing a monochromatic negative. Sensitized paper or gelatine film is also treated with the colorless solution and printed by contact, in the usual way. The print appears like an ordinary one, but is said to have acquired the power of selective absorption for dyes, so that if it is passed successively through solutions of red, green, and blue dyes, a proportionate amount of each color is taken up locally, to reproduce the colors of the natural object. No information is given as to the nature of the liquids used.

**Manufacture of Phosphor Bronze.** By MAX H. WICKHORST. *J. Am. Chem. Soc.*, 19, 393-395.—The phosphorus added to bronze to deoxidize the metal may be introduced as phosphorus or as a high phosphorus alloy, called "hardener." This contains six per cent. of phosphorus, with copper and tin in the ratio of eight to one. The "hardener" is made by melting 90 pounds of copper and adding 11 pounds of tin. Seven pounds of phosphorus are put into a dilute solution of blue vitriol, until coated with metallic copper. This protects the phosphorus when it is dried in the air. After drying, the sticks of copper-plated phosphorus are introduced into the melted bronze, two or three at a time, and held below the surface of the metal by a cup-shaped tool. The phosphorus melts and combines with the metal at once, to form "hardener."

**On the Manufacture of Dynamite.** By G. E. BARTON. *J. Am. Chem. Soc.*, 19, 500-509.—This paper presents a description of the plant and the method used in the manufacture of dynamite. Two classes of dynamite are recognized: that consisting of nitroglycerol absorbed in wood pulp, or kieselguhr, with various fillers, such as sodium nitrate, etc.; and those called gelatin dynamites, consisting of nitroglycerol, gelatinized with nitrated cellulose. The first class is discussed in this article. The numerous precautions to be taken in arranging and in operating the plant, the tests of materials and yields obtained, are all shown. The treatment of the spent acids is also considered, and recovery by running through a Glover tower is advised. The mixing of the nitroglycerol with the absorbent is best done in a wheel-mill with wooden wheels. For packing the dynamite in the cartridge papers, wooden pack-sticks are best.

**The Commercial Preparation of Nitronaphthalenes.** By WILLIAM H. KRUG AND J. E. BLOMÉN. *J. Am. Chem. Soc.*, 19, 532-538.—Nitronaphthalenes are chiefly used in nitroglycerol explosives, to reduce sensitiveness to concussion and to

prevent freezing of the dynamite. It also increases the solvent action of nitroglycerol on nitrated cellulose. The nitronaphthalenes used should be as highly nitrated as possible. In order to determine the conditions necessary for the best yield, the authors tried nitrating naphthalene-sulphonic acid under various conditions, and also nitrating naphthalene directly. It was found that the yield of nitronaphthalene decreased proportionally to the degree of sulphonation in the case of  $\alpha$ -naphthalene-sulphonic acid. Direct nitration of naphthalene gave better yields, and the best results were obtained by using a mixture of nitric acid 26° Bé., and sulphuric acid, the quantity of the latter depending on the degree of nitration desired. For low melting products, four parts of nitric to one of sulphuric were used; for high melting products, three parts to two. An excess of sulphuric acid chars the product, producing much tar.

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## BIOLOGICAL CHEMISTRY.

E. H. RICHARDS, REVIEWER.

**Dietary Studies. The Food of the Negro in Alabama.** By W. O. ATWATER AND CHAS. D. WOODS. *U. S. Expt. Sta. Bul.* No. 38, 1-69.—This report gives in detail the food consumed by eighteen families living in the neighborhood of Tuskegee, Ala., and is by far the most comprehensive contribution to this vital question for the whole race. The cost per man per day ranged from two and one-quarter to nineteen and three-quarters cents. Ten dietaries cost less than eight cents and seven less than six cents per day, yet only five gave an abnormally low fuel value. As might have been predicted from the experience of employers, the nitrogenous substances were uniformly low. Fourteen of the twenty dietaries (two families were tested in both winter and summer) contained from one-fourth to one-half the required proportion.

**Dietaries of the Public Institutions of the City of Boston.** By E. H. RICHARDS AND S. E. WENTWORTH. *Rep. of the Institutions Dept., City Document 14, 1897, 206-219.*—The authors make a statement of the facts established by their investigation, and recommend certain standards for the different classes of public institutions.

**Dietary Studies in New Mexico.** By ARTHUR GOSS. *U. S. Agr. Expt. Sta. Bull.*, No. 40, 1-23.—This Bulletin contains important data not elsewhere found, in the form of analyses of food materials used in the Central American regions, and the dietaries are of more than usual interest in view of our limited knowledge of the food of the Mexicans, both as to quality and cost.

Here, as elsewhere, sufficient food seems to be procurable at a cost of from six to nine cents per person daily.

**The Fruit Soils of Oregon and the Composition of Oregon Prunes.** By G. W. SHAW. *Reprint from Ore. Expt. Sta. Bull.*, No. 45, 1-98.

**Removal of Iron from Ground Waters.** By H. W. CLARKE. *J. N. E. Water Works Assoc.*, 11, 277-284.—The author suggests the use of coke as a more efficient filtering material than sand for the removal of iron from certain classes of waters, and in support of this view gives the results of experiments at Provincetown, Mass.

**The Iron Removal Plant at Reading, Mass.** By LEWIS M. BANCROFT. *J. N. E. Water Works Assoc.*, 11, 294-300.—The use of lime and alum for the removal of iron from a water which does not yield to simple aeration and filtration, is described, and a table of analyses given.

W. R. WHITNEY, REVIEWER.

**Internal Secretion Considered from a Chemico-physiological Standpoint.** By R. H. CHITTENDEN. *Science*, 5, 967-977.—The author treats exhaustively a single internal secretion, that of the rudimentary gland of the neck, the thyroid, known as the seat of the goitre. The effects on the metabolism of persons and animals (both normal and thyroidectomized), brought about by the administration of the gland, or its extracts, are pointed out. These, together with the recognized change produced in the blood and upon the quantity of mucus in different parts of the body, afford sufficient evidence that this vestigial gland produces one or more secretions necessary to the animal body. Concerning the chemical and physiological nature of the principal product, which the author calls "a proteid of peculiar constitution," not much is known. It is peculiar in that "it tends to hold a certain amount of iodine in combination," and yields on decomposition by acids or gastric juices, iodothyroin, a non-proteid, difficultly decomposable compound containing phosphorus and iodine. The physiological action of iodothyroin is further considered, as well as the presence of a relatively high percentage of iodine in the material of the gland.

**The Nitrogen-free Extract of Plants and Feeding Stuffs.** By B. TOLLENS. *U. S. Expt. Sta. Rec.*, 8, 641-661.—This article is introduced by a detailed consideration of the constituents of the so-called carbohydrates of food material, and attention is called to the fact that other substances which are not strictly carbohydrates are here classed as such. Uncertainties

regarding the proper method of analysis of crude fiber are also pointed out, and some erroneous notions regarding the food value of these constituents are corrected. The author properly recognizes the true value of the well-known Wende extraction method and points out the need for more exact and discriminating procedures.

**The Root of Phytolacca Decandra. Part II.** By S. B. FRANKFORTER AND F. RAMALEY. *Am. J. Pharm.*, 69, 281-290.—The paper opens with abstracts of the literature concerning the chemical composition of the root. Of the results of their own investigations, the authors give the percentages of substance extracted by common solvents; a summary of analyses showing the amount of wax, resin, proteids, starch, acid (formic), etc., present; and the results of the study of the sugar extracted. No body of a glucosidal or alkaloidal nature was detected.

**On the Occurrence of Strontium in Plants.** By HENRY TRIMBLE. *Am. J. Pharm.*, 69, 296-297.—The author has demonstrated the presence of strontium in several samples of bark and points to the fact that little or no attention has been given to its possible presence in the ashes of plants other than sea plants.

**Alfalfa or Lucern; Its Chemical Life History.** By JOHN A. WIDTSOE. *Bull. Utah Agr. College*, 48, 1-73.—The paper presents a thorough discussion of the subject, and is so arranged as to show the composition of successive crops of the lucern. It is supplemented by a discussion of the connection between the analytical results and the value of the material as a fodder.

**The Normal Urine.** By CHARLES PLATT. *J. Am. Chem. Soc.*, 19, 382-384.—This paper presents a table showing the mean results of many urine analyses made by the author and by others, and gives the extremes of composition between which the normal urine may lie, including practically all of its constituents.

**The Proteids of Lupin Seeds.** *J. Am. Chem. Soc.*, 19, 454-482; **The Proteids of the Sunflower Seed.** *Ibid.*, 487-493; **The Proteids of the Cow Pea.** *Ibid.*, 494-500; **The Proteid of the White Podded Adzuki Bean.** *Ibid.*, 509-512. By T. B. OSBORNE AND G. F. CAMPBELL.

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## AGRICULTURAL CHEMISTRY.

F. H. THORP, REVIEWER.

**Alkali.** By B. C. BUFFUM. *Wyo. Sta. Bull.*, No. 29, 219-253.—In this paper are given the details of a study of alkali in soil

and its effects upon plants. "White alkali" consists principally of sulphates of sodium and magnesium; one per cent. of these salts in the first two inches of surface soil renders it unproductive, except for plants which can inhabit alkali soils. These are sugar-beets, white clover, sages, and alfalfa. A comparison of the temperatures of alkaline and non-alkaline soils was made, but no difference was detected.

**The Value of Manure from Animals Fed on Linseed Meal.**

By H. SNYDER. *Minn. Agr. Expt. Sta. Bull.*, No. 47, 23.—Pigs were fed on linseed meal and potatoes, and produced daily six pounds of urine and two pounds of dung. The total quantity of nitrogen in the two was 0.09 pound, while that in the food was 0.10 pound. A very large part of the nitrogen was thus returned to the soil when the linseed cake was used as feed.

**The So-called "Natural Plant Food" a Soft Phosphate.** By A. D. SELBY. *Ohio Agr. Expt. Sta. Bull.*, No. 71, 178-184.—An analysis showed "natural plant food," (see this Rev., 3, 41,) to be, in part at least, Florida or Tennessee soft phosphate. A comparison between it and other standard fertilizers with reference to its action in hastening or retarding germination, showed that it retards germination as compared with unfertilized soil, although some of the standard fertilizers exert a still greater retarding action.

**Ammonium Thiocyanate as an Impurity in Ammonium Sulphate.** By H. J. WHEELER AND B. L. HARTWELL. *R. I. Agr. Expt. Sta. Rep.*, 1895, 281-286.—This is a record of experiments with pure ammonium sulphate, and that containing ammonium thiocyanate, on oats. The results demonstrate the poisonous action of the thiocyanate on such plants.

**Analyses of Commercial Fertilizers.** *Agr. Expt. Sta. Bull.*, Vt., 58 and 59, and 9th Ann. Rep., 1896; *Mass. Hatch Sta.*, No. 45; Ky., No. 68; *R. I. Sta. Rep.*, 1895, 39, 287-293; *Mich.*, No. 135; *S. C. Sta. Rep.*, 1895, 54-63; *Mass. Hatch Sta.*, 9th Ann. Rep., 202-223; *Penn. Dept. Agr. Bull.*, 19; *Cal. Sta. Rep.*, 1895, 135-139; *La.*, Series 2, No. 45, 56-80; *Penn. Sta. Rep.*, 1895, 227-236; *R. I.* No. 40, 71-79; *Wis.*, No. 53; *Canada Expt. Farms Rep.*, 1895, 206-219.

**The Fertilization of Land.** By E. W. HILGARD. *Cal. Agr. Expt. Sta. Rep.*, 1895, 123-135.—The effect of crops on the fertility of the soil in California is considered, and the fertilizer requirements studied. The general conclusions reached show that, with the exception of a few localities, the soils of the state contain an abundance of lime, and that acid soils are rare. There is also sufficient potash in most localities, and often an excess. The rain-

fall being generally deficient, this ingredient is not washed away; but the greater part of California soils are deficient in phosphoric acid, and phosphates are the chief fertilizers now required by the farmers. Nitrogen is generally present, but in some localities may need to be supplied. Next to phosphates, nitrogenous fertilizers are probably most in demand, except in the alkali regions, where an excess of nitrogen is present.

**Analysis of Paris Green.** E. W. HILGARD. *Cal. Agr. Expt. Sta. Rep.*, 1895, 137.—The percentage of arsenious acid is stated for two samples.

**Experiments with Soluble, Reverted, and Insoluble Phosphoric Acid.** By E. H. HESS. *Penn. Agr. Expt. Sta. Rep.*, 1895, 157–210.—The author concludes that soluble phosphates are too expensive to use on lime soils, where equally good results are obtained with insoluble phosphates; also that ground bone is superior to ground Carolina phosphate rock.

**Composition of Wood Ashes Sold in Pennsylvania.** By W. FREAR. *Penn. Agr. Expt. Sta. Rep.*, 1895, 224–226.—Analyses of fifteen samples are given, with comments.

**Some Pennsylvania Peats.** By W. FREAR AND E. J. HALEY. *Penn. Agr. Expt. Sta. Rep.*, 1895, 148–156.—The value of peat as a fertilizer is shown by the analyses of thirteen samples. Although bulky, it offers a fertilizer well worth consideration; some varieties, however, need composting with lime or with stable manure.

**Origin, Value, and Reclamation of Alkali Soils.** By E. W. HILGARD. *U. S. Dept. Agr. Yearbook*, 1895, 103–122.—Among other subjects discussed in this article are “the influence of irrigation on the movement of alkali,” and the “composition of alkali salts.”

**Inspection of Paris Green.** By W. C. STUBBS. *La. Agr. Expt. Sta. Bull.*, No. 45 (2nd Ser.).—Analyses of eight samples are given.

**Investigation on the Foraging Powers of Some Agricultural Plants for Phosphoric Acid.** By L. H. MERRILL AND W. H. JORDAN. *Maine Sta. Rep.*, 1895, 10–18.—This paper is a continuation of the study of the fertilizing value of insoluble, as compared with soluble phosphates. Among other conclusions it is stated that young plants feed chiefly on soluble phosphates, while with older plants the insoluble forms are assimilated. The solubility of phosphate in ammonium citrate is not considered a true measure of the availability of phosphoric acid to the plants.

Certain varieties of plants appear better able to assimilate insoluble phosphates than do others.

G. W. ROLFE, REVIEWER.

**The Occurrence of Raffinose in American Sugar-Beets.** By W. E. STONE AND W. H. BAIRD. *J. Am. Chem. Soc.*, 19, 115-124.—The paper presents a discussion bearing upon the occurrence of raffinose in beet-sugar, in which are given the results of the researches of the authors on Nebraska beet-root molasses. They find by a modification of the Kodyl-Sheibler method that raffinose is present. The authors also note the remarkable fact that raffinose in very small amounts changes the character of cane-sugar crystals, so that they closely resemble those of pure raffinose. They illustrate this by photo-micrographs.

**The Sugar-Beet.** By H. W. WILEY. *Farmers' Bull. U. S. Dept. of Agr.*, No. 52, 1-47.—The paper is intended to give concise information in a popular way on the raising of sugar-beets, a comparison of the different varieties, and the effect of climate, soil, fertilizers, irrigation, etc., on the quality of the beets. Methods of cultivation and manufacture, as well as data on the cost are also given. A number of statistical tables on the world's sugar production are added.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

## REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. III. NO. II.

ARTHUR A. NOYES, Editor; HENRY P. TALBOR, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

### GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

**On the Permeation of Hot Platinum by Gases.** By WYATT W. RANDALL. *Am. Chem. J.*, 19, 682-691.—After giving a brief review of the previous work done on the permeation of metals by gases, the author describes the apparatus used in his own experiments. This consists of a platinum tube closed at one end, fitted into a hard-glass tube, and connected at its protruding open end with a Töpler pump and a sparking tube for examining the spectrum. The hard-glass tube and the platinum tube within it are heated to a white heat, a high vacuum is produced in the latter, and carefully dried hydrogen or other gas to be tested is passed through the outer tube. It was found that hydrogen passed through the platinum, though only very slowly, the pressure within the tube (total volume 100 cc.) increasing at the rate of a millimeter in 3-5 minutes. The spectrum indicated that the hydrogen which had passed through the platinum was perfectly pure. On the other hand, when the platinum tube was surrounded with dry air, the vacuum within could be maintained indefinitely. Like oxygen and nitrogen, methane seemed to have no power whatever of permeating the metal.

**The Atomic Mass of Tungsten.** By WILLET LEPLEY HARDIN. *J. Am. Chem. Soc.*, 19, 657-676.—The author has investigated the methods commonly employed in determining the atomic weight of tungsten, consisting in the reduction of its trioxide by hydrogen, and in the reoxidation of the metal by ignition in the air. The results are given of sixty-four determinations

made with the material from different sources. From the discordant results obtained, the author concludes that the method is unsatisfactory, and that this may be due to the action of the substance on the vessel in which it is ignited, to loss mechanically or by volatilization, or to the presence of nitrogen as impurity, all of which sources of error were demonstrated to be actually present.

**Mass Law Studies, III.** By S. F. TAYLOR. *J. Phys. Chem.*, I, 542-546.—See this *Rev.*, 3, 75, 122.

**Solubility of Solids in Vapors.** By J. M. TALMADGE. *J. Phys. Chem.*, I, 547-554.—The author has determined at different temperatures the partial vapor-pressures of naphthalene and camphor in their saturated solutions in ether, acetone, methyl alcohol, and ethyl alcohol. He concludes from his experiments that the partial pressures are different for the different solvents, and that in the case of camphor at least the values are greater than those belonging to the pure substance at the same temperatures. However, as no check determinations are given, it is impossible to judge of the accuracy of the results. Those in the case of naphthalene in ether differ enormously from those of Benedict, previously obtained in the same laboratory. See this *Rev.*, 3, 75.

**Comment on the Note of R. Franchot Entitled "Nascent Hydrogen."** By D. TOMMASI. *J. Phys. Chem.*, I, 555.—A claim for priority.

**Note.** By WILDER D. BANCROFT. *J. Phys. Chem.*, I, 556.—Remarks on the preceding note.

**On the Speed of Reduction of Ferric Alum by Sugar.** By J. H. LONG. *J. Am. Chem. Soc.*, 19, 683-698.—The author determines the rate at which sugar reduces ferric alum by measuring the increase in electrical conductivity which the mixed solutions undergo, and comparing this with that of solutions containing the reaction-products at known concentrations. The results show that the velocity of the reaction is proportional to the amount of sugar present. The author assumes that very little sugar is used up by the reduction, and that therefore its amount remains practically constant during each series of experiments, so that the concentration of the ferric salt alone varies; and he calculates accordingly the constants of the first order. These are found to increase with the progress of the reaction, the acceleration being attributed to the free acid gradually produced by the reaction. The theoretical equation which should express this effect is not that given by the author, but the follow-

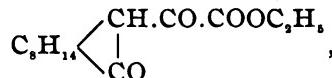
ing one:  $\frac{dx}{dt} = (K + K'x)(A - x)$ , in which  $K'$  is a second constant representing the increase in the reaction-constant  $K$ , caused by acid of unit concentration.

**Early American Chemical Societies.** By H. CARRINGTON BOLTON. *J. Am. Chem. Soc.*, 19, 717-732.—The article is a description of three chemical societies founded in the United States in 1792, 1811, and 1821, respectively.

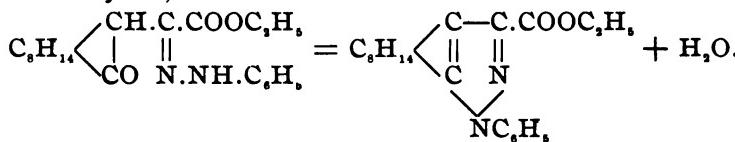
## **ORGANIC CHEMISTRY.**

J. F. NORRIS, REVIEWER.

**The Action of Ethylic Oxalate on Camphor (II).** By J. BISHOP TINGLE. *Am. Chem. J.*, 19, 393-416.—In order to throw some light on the structure of the 1, 3-diketones and keto-acids, the author has undertaken a further study of ethyl camphoroxalate, which was prepared by him a few years ago (*J. Chem. Soc.*, 57, 652). Although the results do not establish the correctness of the carbonyl or hydroxyl formula, they are published in order to reserve the field. Ethyl camphoroxalate,



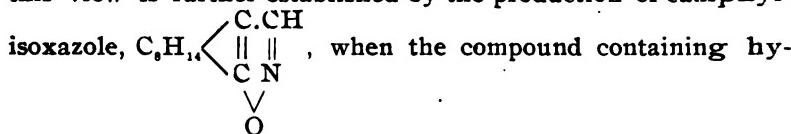
is best prepared by the action of sodium on a mixture of camphor and ethyl oxalate dissolved in ligroin. It does not form a copper salt, is quickly decomposed when heated, and in presence of alkali is rapidly hydrolyzed. A hydrazone is readily formed which loses water and gives ethyl camphylphenylpyrazolecarboxylate.



From the latter ester the acid can be easily formed. Camphoroxalic acid can be boiled with concentrated alkali without decomposition. With hydroxylamine at ordinary temperature, in presence of acid sodium carbonate, it yields an addition-product,  $C_{12}H_{16}O_4.NH_2OH$ . The formation of this favors the hydroxyl formula for the free acid since it is scarcely to be expected that hydroxylamine would yield an addition-product with a substance containing two carbonyl groups. The formula of the compound

is, consequently,  $C_6H_{14}\begin{array}{c} CH.C.OH.COOH \\ | \\ CO\ NH.OH \end{array}$ . The correctness of

this view is further established by the production of camphyl-



droxylamine is heated. The preparation and properties of the above bodies are described in detail.

**On the Molecular Rearrangement of the Oximes by Means of Certain Metallic Salts.** By WILLIAM J. COMSTOCK. *Am. Chem. J.*, 19, 485-492.—Cuprous chloride, cuprous bromide, and antimony trichloride effect the Beckmann rearrangement of the oximes. When a cold concentrated solution of benzaldoxime in dry benzene was treated with cuprous chloride, the latter dissolved and an addition-product separated, crystallizing in colorless needles. Its formula was  $(C_6H_5CH.NOH)_2CuCl$ , but the antioxime was changed into its stereoisomer. When a benzene solution of the addition-product was boiled, cuprous chloride precipitated and benzamide was obtained from the filtrate. By a study of the action of cuprous chloride and bromide on benzaldoxime, cinnamaldoxime, oenanthaldoxime, acetoxime, acetophenoneoxime, and benzophenoneoxime, it was shown that the formation of addition-products of the formula, (Oxime), + CuCl or CuBr, is general. The rearrangement into amide, or substituted amide, by boiling a solution of the cuprous-halide-oxime is not, however, a general reaction and when effected is not a smooth one. When the solution is boiled, there is usually, to some extent, a regeneration of aldehyde or ketone. When a saturated aqueous solution of benzaldoxime or acetoxime was treated with a solution of cupric chloride, the cuprous addition-product separated. A part of the acetoxime was split into acetone and hydroxylamine, which was oxidized to nitrous acid by the cupric chloride. Benzophenoneoxime was changed to benz-anilide by antimony trichloride.

**The Action of Urea and Primary Amines on Maleic Anhydrides.** By FREDERIC L. DUNLAP AND ISAAC PHELPS. *Am. Chem. J.*, 19, 492-496.—In a former article (*Am. Chem. J.*, 18, 333) a method was described for the preparation of imides by the action of urea on the anhydrides of dibasic acids. It was shown that the formation was to be explained by the addition of urea to the anhydride to form an acid which, when heated, decomposed, yielding an imide, carbon dioxide, and ammonia. Maleüric acid, HOOC.CH=CH.CO.NH.CO.NH<sub>2</sub>, has now been prepared in this way, but when heated it did not yield sufficient imide for identification. Following the method of Anschütz

(*Ber. d. chem. Ges.*, 20, 3214) the following compounds have been prepared by the action of primary amines on maleic anhydride:  $\rho$ - and  $\sigma$ -tolylmaleamic acids HOOC.CH=CH.CO.-NHC<sub>6</sub>H<sub>4</sub>CH<sub>3</sub>, and  $\alpha$ - and  $\beta$ -naphthylmaleamic acids, HOOC.CH=CH.CO.NHC<sub>10</sub>H<sub>7</sub>.

**On the Isomeric Chlorides of  $\rho$ -nitro- $\sigma$ -Sulphobenzoic Acids.** By IRA REMSEN AND G. W. GRAY. *Am. Chem. J.*, 19, 496-512.—The results obtained in the investigation of the chlorides of orthosulphobenzoic acids (*Am. Chem. J.*, 17, 309, 311, 330, 347; and 18, 791, 794, 809, 818) have led the authors to undertake a study of the corresponding chlorides of  $\rho$ -nitro- $\sigma$ -sulphobenzoic acid. With the latter acid the separation of the isomeric chlorides is easier. This is effected as follows: A chloroform solution of the mixed chlorides, prepared by the action of phosphorus pentachloride on the acid potassium salt, is allowed to evaporate spontaneously, when the symmetrical chloride, C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub> <sup>COCl</sup> > SO<sub>2</sub>Cl, crystallizes in monoclinic (?) pinacoids and basal planes. When no more crystals can be obtained, the solvent is evaporated off and the resulting oil dissolved in petroleum ether, from which the unsymmetrical chloride, C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub> <sup>CCl</sup> > SO<sub>2</sub>, crystallizes in fine white needles or plates. The action of ammonia is analogous to that on the chlorides of orthosulphobenzoic acid. The symmetrical yields the ammonium salt of the imide, C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub> <sup>CO</sup> > N.NH<sub>4</sub>, and the unsymmetrical the ammonium salt of a cyan acid, C<sub>6</sub>H<sub>4</sub>NO<sub>2</sub> <sup>CN</sup> > SO<sub>2</sub>ONH<sub>4</sub>. From these ammonium salts the corresponding silver, potassium, barium, calcium, magnesium, and zinc salts were prepared. The methyl and ethyl salts of the sulphinide and the free paracyanbenzenesulphonic acid, with its chloride and amide are described.

**A Study of the Action of the Nitrate and Sulphate of Paradiazotoluene on Methyl Alcohol under Various Conditions.** By WILLIAM E. CHAMBERLAIN. *Am. Chem. J.*, 19, 531-547.—From a study of the action of methyl alcohol on the sulphate and nitrate of paradiazotoluene the conclusion is drawn that under atmospheric pressure the alkoxy reaction takes place almost entirely. With the nitrate, lowering of temperature and pressure favors the hydrogen reaction, whereas, under the same conditions, the sulphate gives a better yield of the alkoxy product. When the decompositions were effected in the presence of sodium methylate, potassium hydroxide, potassium carbonate, or zinc dust, the hydrogen reaction alone took place. When zinc oxide

was used the temperature of reaction was higher and both hydrogen and the methoxy group were introduced. It follows, therefore, that the presence of alkaline substance to neutralize the acid set free and a low temperature favor the hydrogen reaction. When paradiazotoluene was decomposed with methyl alcohol some dinitroparacresol was formed. This was shown to be due to the action of the nitric acid set free upon the chief reaction-product, paracresol methyl ether, nitration and saponification taking place at the same time. This saponifying action of dilute nitric acid is unusual and took place only during nitration, as dinitrocresol ethyl ether was not saponified by long boiling with dilute nitric acid.

**The Reaction of the Salts of Nitrodiazobenzene and the Diazobenzoic Acids with Methyl Alcohol.** By GEORGE F. WEIDA. *Am. Chem. J.*, 19, 547-561.—The following facts were established by a study of the decomposition with methyl alcohol of the diazo compounds obtained from the three nitranilines and the three aminobenzoic acids. Orthonitrodiazobenzene sulphate yields nitrobenzene as the only reaction-product that can be isolated; para- and metanitrodiazobenzene nitrates yield mostly nitrobenzene, and some nitranisol. The salts of the diazobenzoic acids all yielded as the principal product of reaction the ethereal salts of the corresponding methoxy acids; with the nitrate of the ortho acid some nitrosalicylic acid, with the sulphate of the ortho acid some methyl benzoate, and with the nitrate of the para acid some free anisic acid are obtained.

**A Study of the Action of Methyl Alcohol on the Sulphate of Orthodiazotoluene.** By WILLIAM BROMWELL. *Am. Chem. J.*, 19, 561-578.—The author comes to the following conclusions from a study of the action of methyl alcohol on the sulphate of orthodiazotoluene: (1) Orthodiazotoluene sulphate is decomposed by methyl alcohol at a lower temperature than the corresponding para compound. (2) When decomposed under atmospheric pressure it gives almost exclusively the alkoxy reaction. (3) Whether decomposition takes place slowly at the temperature of the room or rapidly at a temperature near the boiling-point of the alcohol, the yield of the methoxy product is the same. (4) When orthomethoxytoluene is treated with cold concentrated sulphuric acid, only one sulphonate acid is formed, which has the formula  $\text{CH}_3\text{C}_6\text{H}_4\text{OCH}_3\text{SO}_3\text{H}$ , and which forms well-characterized barium, calcium, magnesium, zinc, copper, lead, sodium, and potassium salts. (5) Methoxytoluenesulphonic acid forms a chloride and an amide which is oxidized by potassium permanganate to the acid  $\text{CH}_3\text{OC}_6\text{H}_4\text{COOH}\text{SO}_3\text{NH}_3^+$ .

**On the Action of Potassium Hydroxide on Orthomethoxy-sulphaminebenzoic Acid.** By CHARLES WALKER. *Am. Chem. J.*, 19, 578-581.—The methoxysulphaminebenzoic acid,  $\text{CH}_3\text{O} \cdot \text{C}_6\text{H}_4 \cdot \text{COOH} \cdot \text{SO}_2\text{NH}_2$ , obtained by Bromwell (preceding review) was fused with potassium hydroxide, in order to establish its constitution. This was not determined, as the sulphamine group remained intact, the resulting compound being orthoxysulphaminebenzoic acid,  $\text{OH} \cdot \text{C}_6\text{H}_4 \cdot \text{COOH} \cdot \text{SO}_2\text{NH}_2$ . Its barium, calcium, sodium, and silver salts were prepared. When heated with hydrochloric acid in a sealed tube salicylic acid was obtained.

**Aluminum Alcoholates.** By H. W. HILLVER. *Am. Chem. J.*, 19, 597-603.—In a former paper the author showed (*Am. Chem. J.*, 19, 37) that aluminum alcoholates were formed by the action of aluminum on alcohols in the presence of certain anhydrous chlorides. When absolute alcohol is poured on chipped aluminum and either platinic, mercuric, or stannic chloride added, hydrogen is evolved and a rapid deposition of metal takes place with rise in temperature. A large amount of aluminum is dissolved, and a pasty reaction-product, an alcoholate, is formed. The addition of a saturated solution of hydrochloric acid in alcohol produces the same effect as the metallic chloride. The best yields are obtained when a small amount of an alcoholic solution of stannic chloride is added to the absolute alcohol containing the aluminum. Methyl alcohol acted as above, but the resulting compound could not be isolated, as it decomposed on distillation. Considering the fact of the evolution of hydrogen rather than a hydrocarbon, and the presence of aluminum in solution in a form not the chloride, the reaction can best be explained as follows:  $2\text{Al} + 6\text{CH}_3\text{OH} = 2\text{Al}(\text{OCH}_3)_3 + 3\text{H}_2$ . Aluminum propylate was isolated by fractional distillation and analyzed. Amyl alcohol also furnished a volatile compound, but aluminum isopropylate decomposed before distillation. The nascent hydrogen formed in this reaction furnishes a method of reduction in the entire absence of water.

**Behavior of Chloral Hydrate with Ammonium Sulphide.** By JOSEPH LESINSKY AND CHARLES GUNDLICH. *Am. Chem. J.*, 19, 603-606.—A precipitate of unknown composition was formed by the action of yellow ammonium sulphide on a solution of chloral. By varying the concentrations of the solutions the color of the precipitate varies from pink to yellow and changes to brown or black on heating. The time required for

precipitation decreases as the temperature increases. The authors propose to study the reaction more carefully and to use it in testing the purity of chloral hydrate.

**On Halogen Addition-Products of the Anilides.** By H. L. WHEELER, BAYARD BARNES, AND J. H. PRATT. *Am. Chem. J.*, 19, 672-682.—Wheeler and Walden (*Am. Chem. J.*, 18, 85) showed that the anilides form perhalides, and it was concluded that the compounds are analogous to the perhalides of caesium and ammonium. In order to test the correctness of this view a crystallographic study of some organic and inorganic perhalides has been made. As ammonium triiodide is analogous to the perhalides of the alkali metals and shows no crystallographic analogy to the derivatives of the anilides it is concluded that it differs from the latter in structure. The view is strengthened by the fact that all of the organic perhalides are formed from salts containing two molecules of the anilide and one of the halogen acid. Perhalides from the 1:1 salts have not been prepared. The most probable structure of the salt (CH<sub>3</sub>CO.  
 $\text{H}_3\text{N}(\text{COCH}_3)\text{C}_6\text{H}_5$ ,  
 $\text{NHC}_6\text{H}_5\text{).HCl}$  is | . The perhalides are



thought to be addition-products of compounds with this di-ammonium structure. Another striking difference between the alkali and anilide perhalides is the ease with which the latter can be obtained containing two halogens. A large number of salts and mixed perhalides of acetaniline and methyl metanitro-acetanilide were prepared and studied crystallographically. It is shown incidentally that formanilide forms the salt (HCO.  
 $\text{NHC}_6\text{H}_5\text{).HCl}$ , and therefore acts like a true anilide, whereas, if it had the imido structure, the hydrochloride should be a 1:2 salt.

**On Some Malonic Acid Derivatives.** By RICHARD S. CURTISS. *Am. Chem. J.*, 19, 691-702.—Ethylenilido malonate, C<sub>6</sub>H<sub>5</sub>NH.CH(COOC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>, was formed when bromethyl malonate was treated with aniline. It gives a crystalline compound with hydrochloric acid gas, a sodium salt with sodium ethylate, a bromine addition-product, and reduces ammoniacal silver nitrate in the cold. When oxidized with mercuric oxide ethylenilido malonate, (C<sub>6</sub>H<sub>5</sub>NH)<sub>2</sub>C(CO<sub>2</sub>C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>, is formed. The same compound was prepared from dibromethyl malonate and aniline. Sodium ethylate and dibromethyl malonate gave a complex mixture from which ethyl diethoxymalonate (C<sub>6</sub>H<sub>5</sub>O)<sub>2</sub>C(CO<sub>2</sub>C<sub>2</sub>H<sub>5</sub>)<sub>2</sub> was isolated by fractional distillation.

**The Action of Nitric Acid on Triphenylmethane.** By E. S. SMITH. *Am. Chem. J.*, 19, 702.—In an attempt to make trinitrotriphenylmethane by the action of fuming nitric acid on triphenylmethane, triphenylcarbinol was obtained. It was impossible to discover the exact conditions necessary, as repetition of the work always yielded the usual nitro derivatives.

**Halides and Perhalides of Pyridine.** By P. F. TROWBRIDGE AND O. C. DIEHL. *J. Am. Chem. Soc.*, 19, 558–574.—This is a continuation of a paper recently reviewed (*this Rev.*, 3, 112). Reference must be made to the original article for a description of the large number of compounds prepared.

## ANALYTICAL CHEMISTRY.

### ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

**A Modification of the Permanganate Method for the Determination of Iron.** By HAMILTON P. CADY AND ALFRED P. RUEDIGER. *J. Am. Chem. Soc.*, 19, 575–581. The reducing action of hydrochloric acid upon potassium permanganate during an iron titration may be prevented by the introduction into the solution of mercuric sulphate. The mercury ions at once tend to unite with the chlorine ions of the hydrochloric acid to form mercuric chloride, and this slightly ionized compound does not influence the permanganate. The results which the authors obtained by this modification of the permanganate process are satisfactory.

**Notes on the Determination of Insoluble Phosphorus in Iron Ores.** By CHARLES T. MIXER AND HOWARD W. DUBOIS. *J. Am. Chem. Soc.*, 19, 614–619.—The authors determine the soluble phosphorus in a solution of the ore obtained by treatment with hydrochloric acid (sp. gr. 1.10). The insoluble residue is filtered, dried, and ignited for a short time at a red heat, after which the remaining phosphorus may be readily extracted by dilute acid. Analyses of the insoluble residues indicate that the phosphorus is probably in combination with alumina.

**A Further Communication on the Estimation of Phosphoric Acid by Titration of the Ammonium Phosphomolybdate Precipitate with Standard Alkali.** By B. W. KILGORE. *J. Am. Chem. Soc.*, 19, 703–711.—Two main objections have been raised to the adoption of this method as an official procedure;

*viz.*, insufficient proof of its applicability to various sorts of fertilizer material, and the difficulty in removing all the acid from the precipitate. The first objection the author meets by presenting satisfactory analyses of a wide variety of materials, made by this procedure; the supposed difficulty in washing the precipitate the author believes to be apparent rather than real.

**The Exact Dilution of Liquids by Formula.** By CHAS. D. HOWARD. *J. Am. Chem. Soc.*, 19, 587.

W. H. WALKER, REVIEWER.

**A New and Rapid Method for the Qualitative Separation of Iron, Aluminum, Chromium, Manganese, Zinc, Nickel, and Cobalt.** By ALEXANDER RAMSAY CUSHMAN. *Am. Chem. J.*, 19, 606-607.—This separation is based upon the behavior of the above metals with bromine water, first in the presence of strong aqueous ammonia, by which the iron, manganese, chromium, and aluminum are separated from the zinc, nickel, and cobalt, and later in the presence of an excess of potassium hydrate, which separates the iron and manganese from the aluminum and chromium. The further separation and identification of the metals is carried out in the main according to well-known procedures. No provision is made for the detection of the alkaline earth phosphates, which may be thrown down with the ammonium sulphide precipitate, and this the reviewer thinks must seriously limit the general application of the method.

**The Actual Accuracy of Chemical Analyses.** By F. P. DEWEY. *Trans. Am. Inst. Min. Eng.*, 26, 370-379.—This paper does not consider ways and means for the increase of analytical accuracy, nor the question of what could or should be attained in this direction; it is an extensive résumé of the results exhibited in actual every day practice, and does not admit of a brief review.

**Titration of Sodium Thiosulphate with Iodic Acid.** By CLAUDE F. WALKER. *Am. J. Sci.*, 154, 235-242.—The nature of the reaction between thiosulphuric acid and iodic acid is here studied to determine the expediency of using one acid in standard solution for the direct titration of the other. It has been stated that when sodium thiosulphate is titrated with iodic acid, the reaction takes place according to the equation:



Under these conditions no free iodine will be liberated until all the thiosulphate has been oxidized; the first drop of iodic acid

in excess, however, will liberate iodine according to the equation :



thus furnishing an end-point. The results of many titrations made during this investigation are tabulated and show that the reaction does not always take place according to the above equations, but that "it is so indefinite in its nature and so dependent for its completeness on conditions of time, dilution, and mass that its direct application as a means of standardizing solutions must remain impracticable."

### ASSAYING.

H. O. HOFMAN, REVIEWER.

**The Assay by Prospectors for Auriferous Ores and Gravels by Means of Amalgamation and the Blow-Pipe.** By W. H. MERRITT. *Trans. Am. Inst. Min. Eng.*, 26, 187-192.—The method recommended by the author is similar to that used by Leonard (*this Rev.*, 2, 75); it is the one taught in the prospector-classes of the School of Mines, Kingston, Ont. The ore having been sampled down to 2 pounds is ground to pass a 40 or 60-mesh sieve, transferred to a mortar which has been charged with water, 1 ounce quicksilver, and a small amount of sodium amalgam, and rubbed with a wooden pestle. The pulp is transferred to a pan, and quicksilver concentrates and tailings are separated. The amalgam is retorted in a small cup-shaped vessel of Russia-iron, the quicksilver condensed in a hollowed-out potato, the spongy bullion from the cup mixed with lead, fused on charcoal and cupelled on a clay pipe, and the relative proportion of gold and silver estimated by the color. The balance used is one with a sliding weight weighing from 0.1 to 0.5 grain and costing \$3.00. By taking as much as 2 pounds of ore for a test, the values of ores running as low as \$3.60 in free-milling gold can thus be approximately determined. The paper closes with a detailed description of the apparatus required and its cost.

### GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

W. O. CROSBY, REVIEWER.

**On the Identity of Chalcostibite (Wolfsbergite) and Guejarite, and on Chalcostibite from Huanchaca, Bolivia.** By S. L. PENFIELD AND A. FRENZEL. *Am. J. Sci.*, 154, 27-35.—This

paper is the record of an elaborate chemical and crystallographic investigation based upon all the available material from various sources; and the authors have conclusively demonstrated that we have in this rare sulphide of antimony and copper but one mineral species, for which the chemically descriptive name chalcostibite has priority.

**Native Iron in the Coal Measures of Missouri.** By E. T. ALLEN. *Am. J. Sci.*, 154, 99-104.—Three occurrences of the native iron, in as many different counties, are described. It was found in each instance in drilling through the Coal Measure sandstone, at depths of 35, 37, and 51 feet. The iron appears to occur in more or less continuous masses in the solid rock, offering great resistance to the drill, and the samples obtained consist chiefly of fragments detached from these masses in drilling, the largest weighing 45 grams. The analyses show: iron, 97.10 to 99.39; silica (originally from the sandstone), 0.31 to 1.65; phosphorus, 0.13 to 0.207; and traces of carbon. These irons are undoubtedly of terrestrial origin, and were certainly not derived from the drills. They are characterized by exceptional softness, and are attributed to the reducing action of the carbonaceous matter of the enclosing formation. The complete absence of nickel, so characteristic of meteoric irons, confirms this theory of their origin.

**On Bixbyite, a New Mineral, and Notes on the Associated Topaz.** By S. L. PENFIELD AND H. W. FOOTE. *Am. J. Sci.*, 154, 105-108.—The bixbyite, named after the discoverer, occurs sparingly on the border of the desert in Utah, and is attributed to fumarole action. The mineral is isometric, metallic, brilliant-black, with black streak, hardness 6 to 6.5, and specific gravity 4.945. The average of two analyses gave:  $\text{SiO}_2$ , 1.21;  $\text{Al}_2\text{O}_3$ , 2.53;  $\text{Fe}_2\text{O}_3$ , 47.98;  $\text{TiO}_2$ , 1.70;  $\text{MnO}$ , 42.05;  $\text{MgO}$ , 0.10; available oxygen, 4.38; total, 99.95. The silica and alumina are regarded as impurities. Neglecting these, two formulas are possible:  $\text{R}_2\text{O}_3$ , where  $\text{R} = \text{Fe}$ ,  $\text{Mn}$ , and a little  $\text{Ti}$ ; or  $\text{FeO}\cdot\text{MnO}_2$ . The latter best accords with the isometric crystallization, and suggests relationship to the isometric species perofskite,  $\text{CaO}\cdot\text{TiO}_2$ , and after further discussion of the analyses the conclusion is reached that the mineral really is  $\text{FeO}\cdot\text{MnO}_2$ , in which small quantities of  $\text{MgO}$  and  $\text{MnO}$  are isomorphous with  $\text{FeO}$  and a little  $\text{TiO}_2$ , with  $\text{MnO}_2$ . In other words, it is a ferrous salt of manganous acid,  $\text{H}_2\text{MnO}_4$ , corresponding to braunite,  $\text{Mn}\cdot\text{MnO}_2$ . The associated topaz is described crystallographically, but was not analyzed.

**Note Concerning the Composition of Ilmenite.** By S. L. PENFIELD AND H. W. FOOTE. *Am. J. Sci.*, 154, 108-110.—The existence of a molecule  $R^{II}O.R^{IV}O_2$ , in bixbyite and perofskite brings to mind the views concerning the composition of ilmenite. One of these is that the mineral is  $RO.TiO_3$ , ( $R = Fe$  and  $Mg$ ) ; the other, that it is  $R_2O_3$ , or an isomorphous mixture of  $Fe_2O_3$  and  $Ti_2O_3$ . Crystallographically, ilmenite is not intermediate between hematite and artificial  $Ti_2O_3$ , as the second formula would require ; and the formula fails to account for the  $MgO$  in almost all the ilmenites that have been analyzed. Rammelsberg found 13.71 per cent.  $MgO$  in an ilmenite from Warwick, N. Y. ; and this high value having been questioned, the analysis was repeated by Foote, and 15.97 per cent.  $MgO$  obtained. In the two analyses the ratio of  $RO_3 : RO$  is very close to 1 : 1, thus indicating the existence of the molecule  $RO.TiO_3$ , where  $R = Fe$  and  $Mg$ .

**Igneous Rocks of the Leucite Hills and Pilot Butte, Wyoming.** By WHITMAN CROSS. *Am. J. Sci.*, 154, 115-141.—This paper is a detailed petrographic description of leucitic lavas occurring in the forms of plugs or volcanic necks and surface flows, and the author differentiates what has hitherto been regarded as one type under the names *Wyomingite*, *Orendite* and *Madupite*. Chemical analyses of these types, together with analyses of some of their constituent minerals, and of the leucitic lavas of Montana (leucitite and missourite), are given in tabular form and are remarkable for their complexity, more than twenty-five elements occurring in determinable amounts. In the discussion of the analyses it is noted that  $TiO_3$ ,  $Cr_2O_3$ ,  $BaO$ , and  $Fl$  are found chiefly in the phlogopite, that the sulphuric acid indicates the occurrence of noselite in the rock, and that these lavas are exceptionally rich in  $P_2O_5$ . The most striking fact revealed by the analyses is the almost identical chemical constitution of two rocks, one rich in leucite and free from sanidine (*wyomingite*), the other with predominant sanidine (*orendite*). The conclusion that the chemical composition of a magma does not alone determine whether leucite or sanidine shall be formed, but that this is controlled by conditions of consolidation, is unavoidable. From the analyses the proportions of the component minerals in each rock are computed ; and after a discussion of the classification, nomenclature, and magmatic relations of these lavas, the paper concludes with an account of some interesting inclusions, and the action of the magma upon them. A rather unique, though quite incidental, mineralogical feature of these masses of lava is the occurrence in sheltered cavities and recesses of notable developments of nitre, which proves, on analysis, to be potas-

sium nitrate in some cases and sodium nitrate in others. Although the nitric acid is most probably of organic origin, the potash and soda are supposed to have been derived directly from the adjacent volcanic rock.

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# REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor; HENRY P. TALBOT, Associate Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, W. R. Whitney; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Technical Chemistry, A. H. Gill and F. H. Thorp.

## GENERAL AND PHYSICAL CHEMISTRY.

H. M. GOODWIN, REVIEWER.

**Relations between the Melting-Points and the Latent Heats of Fusion of the Metals.** By JOSEPH W. RICHARDS. *J. Franklin Inst.*, 143, 379-383.—In 1893 the author pointed out that the latent heat of fusion of most metals is approximately one-third of the total heat required to heat them from  $-273^{\circ}$  to their melting-points. As more recent observations have confirmed this relation, the author has collected all data bearing on this subject, and he points out the limits within which the rule apparently holds true. With the exception of bismuth, tin, gallium, and aluminum, the agreement is striking. The first two of these metals Pictet also found to be exceptions to his rule that the absolute melting-point of an element is inversely proportional to its coefficient of expansion,  $\alpha$ , and to the cube root of its atomic volume,  $V$ ; that is,  $T = \frac{4.5}{\alpha \sqrt[3]{V}}$ . Aluminum, too, is known to be anomalous in many of its properties.

If the specific heat be assumed nearly constant from  $-273^{\circ}$  to  $100^{\circ}$ , then the total heat contained in an atomic weight of any metal at its melting-point will be approximately  $6.4T$  (Dulong and Petit's Law). Hence, according to the author's relation between latent heat and total heat, the latent heat of fusion ( $L$ ) of one atomic weight of a metal will be  $2.1 T$ . Combining this with Pictet's formula given above, we get  $L = \frac{9.5}{\alpha \sqrt[3]{V}}$ . Using Pictet's values of  $\alpha \sqrt[3]{V}$ , the agreement between the computed and observed values of  $L$  is (with the exception of aluminum) within the limits of error of the data used for comparison.

**On the Second Differential Coefficients of Gibbs's Functions**  
**2. The Vapor Tensions, Freezing- and Boiling-Points of**  
**Ternary Mixtures.** By W. LASH MILLER. *J. Phys. Chem.*, I,  
 633-642.—The author discusses the physical interpretations  
 which  $\mu$  may have in the equations

$$\left( \frac{d\mu_1}{dm_1} \right)_{t,p,m_1, m_2, \dots} = \left( \frac{d\mu_2}{dm_2} \right)_{t,p,m_1, m_2, \dots} = \text{etc.},$$

these equations being delivered by partial differentiation of Gibbs's function, the order of differentiation being immaterial. The phenomena with ternary mixtures, observed by McIntosch, Bancroft, and others, are shown to be in agreement with conclusions to be drawn from the above relations.

**The Specific Gravities of Water Solutions of Formic Acid.** By GEO. M. RICHARDSON AND PIERRE ALLAIRE. *Am. Chem. J.*, 19, 149-151.—A table is given showing the specific gravity of seventy-one formic acid solutions varying in concentration from pure acid to a 0.6 per cent. solution. The determinations were made with a piconometer at 20° C. Special attention was given to the purity of the acid.

**Some Boiling-Point Determinations.** By H. J. STEUBER. *J. Phys. Chem.*, I, 643-646.—The effect of the addition of sodium chloride and of sugar on the boiling-point of mixtures of alcohol and water was studied. In all cases a rise of boiling-point was observed, but this was less than that observed in water alone. The effect of the presence of alcohol was less, the greater the concentration of the solution with respect to the dissolved salt.

**A New Method of Determining the Specific Heat of Liquids.** By ROBERT L. LITCH. *Phys. Rev.*, 5, 182-185.—The rise of temperature produced by a coil of wire placed in the liquid in the calorimeter is exactly compensated by the addition of a quantity  $m$  of cooler liquid of known temperature  $T_0$  (approximately 0° C.). This is easily affected in a slightly modified form of Waterman's Calorimeter (see *this Rev.*, 3, 19). The heat  $H$  generated in the calorimeter is determined from measurements of the current, resistance, and time. The specific heat is then calculated from the equation  $S = \frac{H}{m(T - T_0)}$ , where  $T - T_0$  is the difference between the temperature of the added liquid and that of the calorimeter. Preliminary results on water are given. These indicate a slight decrease in the specific heat between 18.8° and 21.2°. Further experiments are to be made with two calorimeters containing heating coils in series, the first calorimeter containing a liquid of known specific heat, and the second

the liquid under examination. This latter method has the advantage of eliminating measurements of current and time.

**Radiation in a Magnetic Field.** By A. A. MICHELSON. *Astro-Phys. J.*, 6, 48-55.—The author has examined the phenomenon discovered by Zeeman with his very sensitive interferometer, and finds that in general the effect of the magnetic field is to separate rather than broaden the lines, and that the phenomenon is not of the nature of a reversal. Thus with sodium, the lines are doubled in a field up to about 2,000 C. G. S. units, the separation being nearly proportional to the strength of field. Beyond this point the components become broadened as well as separated with increased strength of field. The broadening effect was noticeable only when the pencil of light was at right angles to the field. The red cadmium line gave similar but even more pronounced results. The green and blue cadmium lines, and the green line of mercury, on the other hand, were both separated and broadened. The hydrogen, lithium, and thallium lines were but slightly affected by the magnetic field.

**Changes in the Wave-Frequencies of the Lines of Emission-Spectra of Elements, Their Dependence upon the Elements Themselves and upon the Physical Conditions under which They are Produced.** By W. J. HUMPHREYS. *Astro-Phys. J.*, 6, 169-233.—The principal results of this interesting investigation, carried out with the exceptional facilities for spectroscopic research of Prof. Rowland's laboratory, are embodied in the following summary: "1. Increase of pressure causes all isolated lines to shift towards the red end of the spectrum. 2. This shifting is directly proportional to the increase of pressure. 3. It does not depend upon the partial presence of the gas or vapor producing the lines but upon the total pressure. 4. The shift of the lines seems to be nearly or quite independent of temperature. 5. The lines of bands (at least of certain cyanogen and aluminum oxide bands), are not appreciably shifted. 6. The shifts of similar lines of a given element are proportional to the wave length of the lines themselves. 7. Different series of lines (as described by Kaysen and Runge) of a given element are shifted to different extents. When reduced to the same wave-length these shifts are to each other approximately as 1 : 2 : 4, respectively, for the principal first and second subordinate series. 8. Similar lines of an element, though not belonging to a recognized series, are shifted equally (when reduced to the same wave-length), but to a different extent than those unlike them. 9. Shifts of similar lines of different substances are to each other, in such cases, as the absolute temperature of the melting-points of the elements that produced them. 10. The shifts of similar

lines of different elements are to each other approximately as the products of the coefficients of linear expansion and cube roots of the atomic volumes of the respective elements (in the solid state) to which they are due. 11. Analogous or similar lines of elements belonging to the same half of a Mendelejeff group, shift proportionally to the cube roots of their respective atomic weights. 12. The lines of these substances, which in the solid form have the greatest coefficients of linear expansion, have the greatest shifts. The converse is also true. 13. The shift of similar lines is a periodic function of atomic weight, and consequently may be compared with any other property of the elements, which itself is a periodic function of their atomic weights." These conclusions are drawn from a careful study of a great many photographs of the arc spectra of the metals taken under varying conditions. The arc was enclosed in an air-tight box, the pressure in which could be varied and measured. A six-inch concave grating of twenty-one and a half feet focal length, ruled with 20,000 lines to the inch, was used. The author suggests several hypotheses of a kinetic nature to account for the shifting of the lines observed.

**On the Conditions Required for Attaining Maximum Accuracy in the Determination of Specific Heat by the Method of Mixtures.** By F. L. O. WADSWORTH. *Am. J. Sci.*, 154, 265-283.—This author gives a precision discussion of the formula for calculating specific heat by the method of mixtures, with special reference to the cooling correction as determined by the methods of Rumford, Jamin, Regnault, and Holman. This is followed by the description of a method by which the correction for radiation is wholly eliminated. It is essentially a perfection of Rumford's method, in which the temperature of the surroundings is so determined and adjusted before the experiment that the maximum temperature reached is that which the calorimeter would have attained had no loss by radiation occurred. Two preliminary series of measurements on the rate of cooling are necessary for the determination of the proper initial temperature of the surroundings. A modification of Regnault's apparatus is also described, by which the hot body is transferred in a little car sliding upon rails from the heater to the calorimeter, where it is dropped in by means of an ingeniously contrived trap. A convenient method of filling an ice calorimeter with water is described, and the advantage is pointed out of placing the calorimeter in a bottle containing partially frozen distilled water.

## TECHNICAL CHEMISTRY.

F. H. THORP, REVIEWER.

**System of Tanning in India.** By K. E. TALATI. *Leather Manufacturer*, 8, 43.—This short article describes the crude process as carried on near Bombay. The hides are "limed," but not "bated." Ten days or more are required for liming, unhairing, and fleshing the skins. The tanning proper is done with a decoction of *acacia auriculata*, or *turwar* bark. The extract, at 12° Bk., is made with cold water, and the skins lie in the liquor ten days. They are then treated with stronger liquor for twelve days more. After removal from the bark solution, the hides are steeped four days in myrabolans liquor, made with hot water. They are then wrung and oiled with sesame oil or ground-nut oil; and are dried in the air.

**New Method of Chrome Tanning.** By Wm. M. NORRIS. *Leather Manufacturer*, 8, 38-39.—The article is an abstract by the inventor of U. S. Patent No. 588,874. Metallic zinc is added to the reducing bath of sodium thiosulphate or sodium bisulphite. The free acid in the bath attacks the zinc and the hydrogen liberated converts the sulphurous acid into hyposulphurous acid, a more powerful reducing body.

**Producing Fancy Leathers.** By H. C. STANDAGE. *Leather Manufacturer*, 8, 22-23, 44-45.—This is a general description of the process of making Morocco and imitation Morocco leathers.

**The Influence of the Gravity of Glycerine on the Yield of Nitroglycerine.** By W. E. GARRIGUES. *Proc. Eng. Soc. Western Pa.*, 13, 265.—The author wished to determine whether variations of two or three units in the third decimal place of the specific gravity of glycerine, has any effect on the yield of nitroglycerine, when calculated from the actual quantity of glycerine nitrated. A series of experiments on four samples of glycerine of 1.2623, 1.2613, 1.2600, and 1.2572 sp. gr., respectively, where the percentage of glycerine varies from 99 to 97, show that the small quantity of water present has no practical effect on the yield of nitroglycerine. All samples were nitrated with the same acid mixture and under exactly similar circumstances. He concludes that with commercial glycerine above 1.257 sp. gr. or 97 per cent. glycerine, the value is exactly according to its percentage of strength. The details of the experiment are fully explained. The author also demonstrates that the yield may be influenced by the method of separating the acid and nitroglycerine. If separated by settling only, the yield is less than if the charge is "drowned" in an excess of water. But since the lat-

ter method gives a milky product, he intimates that the apparent increase may be due to absorbed water. The method of determining the specific gravity of glycerine by the use of the piconometer is also explained.

**Softening Agents for the Production of Asphalt Cement for Paving and other Purposes. Chemical Constitution of Residuums and Malthas, and Its Relation to Water Action. Solubility of the Asphalt Hydrocarbons in Heavy Petroleum Oil.** By CLIFFORD RICHARDSON. *Municipal Eng.*, 12, 343; 13, 1, 67.—These papers form a series of popular articles, containing some tables of the properties and composition of asphalts, malthas, and residuums.

**How to Analyze Clay.** By HOLDEN M. ASHBY. *Brick*, 7, 57, 113, 148.—This is a series of illustrated articles on the methods of analysis employed for clay. The articles are copyrighted and appear to be abstracts from notes prepared by the author for the use of students or others desiring instruction in chemical analysis as applied to clay alone.

**Nitrosylized Blast Furnace Slag as an Addition to Hydraulic Cement.** By A. D. ELBERS. *Eng. Min. J.*, 63, 661, 364, 454.—To make "nitrosylized" slag, finely ground slag is moistened with weak nitric acid, water is added after the acid has become neutralized, and the leached mass is dried. Each 100 pounds of slag requires one-half pound of 60 per cent. ( $\text{N}_2\text{O}_5$ ) acid and 30 pounds of water. The object is the removal of calcium sulphide from the slag. The "nitrosyl" ( $\text{NO}_?$ ) set free by the action of the acid on the slag, is absorbed by the ferrous silicate in the slag, thus, it is supposed, rendering its silica more "disposed to sever its connection with the ferrous oxide and to become gelatinous when acted upon by the dissolved lime." It also prevents the formation of ferric hydrate, since the iron is rendered soluble and is washed away, while gelatinous silica deposits on the surface of the slag particles. Briquettes of slag, which had been treated thus, were tested in various ways; the author concludes, from the results, that ordinary and inferior Portland cements may be mixed with such slag, without diminishing their strength, but only small quantities should be added to high grade cements.

**Composition and Formation of Tank Residues in Electrolytic Copper Refineries.** By EDWARD KELLER. *J. Am. Chem. Soc.*, 19, 778-782.

**The Chemistry of the Pottery Industry.** By KARL LANGENBECK. *J. Franklin Inst.*, 143, 321.—The article represents

a lecture given before the Institute. A few analyses are tabulated.

W. R. WHITNEY, REVIEWER.

**The Manufacture and Applications of Lactic Acid.** By A. A. CLAFLIN. *Am. J. Pharm.*, 69, 599-604.—The paper contains extracts from the note-book of a chemist engaged in the manufacture of lactic acid. The process is the fermentation of glucose by the bacillus acidi lacti, which the author, by inadvertently omitting the prefix micro, describes as "averaging in length 2-2.5 millimeters." A saccharine solution containing 7.5 to 11 per cent. saccharine matter, of which 10-15 per cent. is advantageously cane sugar, is employed. The solution should also contain albuminoid matter and preferably a quantity equal to about 8 per cent. of the saccharine matter. After sterilization the solution is impregnated with the bacillus at 45°, below which temperature the fermentation takes place. Milk of lime is added from time to time to counteract the increasing acidity of the solution. To obtain the purest lactic acid, the calcium lactate is crystallized from the solution after the glucose is almost completely fermented, and the acid is obtained by distilling the salt with sulphuric acid.

**Formaldehyde.** By O. I. AFFELDER. *Proc. Eng. Soc. Western Pa.*, 13, 350-362.—This paper is divided into three parts entitled preparation, reactions, and determination. In the first part modifications of the method of Tollens are described. The methyl alcohol vaporized with air was passed through a heated iron pipe instead of glass, as described by Tollens. A table is given showing the effect of varying the rate of the air current which passes through the methyl alcohol. The maximum yield of aldehyde occurred when 0.7 cubic foot of air passed per hour. The effect of various temperatures of the iron pipe was also studied. It was found that below 25° C. little or no aldehyde is formed. At 350° a maximum is reached. A description of lamps to be used in forming aldehyde by combustion of the alcohol, with or without the use of gas, is given. The article is concluded with a very complete collection of the qualitative tests and methods of quantitative analysis of formaldehyde.

A. H. GILL, REVIEWER.

**Certain Phenomena of Gas Explosions.** By W. H. BIRCHMORE. *Am. Gas Light J.*, 67, 563-565.—The article deals with the explosion or combustion of mixtures of air and hydrogen, air and detonating gas, and air and acetylene. The experiments took place in a tube instead of a bulb; and in the case

of the acetylene they are instructive as showing how the Paris explosion may have taken place. The article is written in a popular style and gives no experimental data.

**Anhydrous Ammonia for Ice Machines.** By H. FAUROR. *Am. Gas Light J.*, 66, 728.—The author recommends the testing of the liquid ammonia used for refrigeration. The common gaseous impurities are air and the constituents of illuminating gas. These can be detected by discharging the ammonia into water and analyzing the insoluble gases. The liquid impurities are water and oils; these are detected by allowing 50 cc. of the liquid to evaporate in a tube with a narrow graduated bottom, the volume of the residual liquid being noted. The boiling-point of commercial ammonia should not be higher than  $-28.6^{\circ}$  F.

G. W. ROLFE, REVIEWER.

**Spontaneous Combustion of Molasses.** By J. T. CRAWLEY. *J. Am. Chem. Soc.*, 19, 538-542.—An account is given of an investigation into a curious case of spontaneous combustion of a tank of molasses at an Hawaiian sugar-house. The author found that fully eighty per cent. of the sugars in the molasses, besides most of the gums and mucilages, had been destroyed. He can give no satisfactory explanation of the cause of combustion, but is inclined to believe that the decomposition of the non-sugars may have much to do with it.

**On the Use of Silico-Fluorides in Sugar Refining.** By WALTER MILLS. *La. Planter and Sugar Mfgr.*, 19, 188-189.—The author attributes the failure of hydrofluosilicic acid as a refining agent to its inverting action; and he recommends the use of the ammonium salt, which is free from this drawback and which, moreover, precipitates lime salts as well as the alkalies. The experiments of the author show that 34.8 per cent. of the ash is removed by this agent.

## BIOLOGICAL CHEMISTRY.

W. R. WHITNEY, REVIEWER.

**The Action of Certain Bodies on the Digestive Ferments.** By FRANK D. SIMONS. *J. Am. Chem. Soc.*, 19, 744-754.—The bodies referred to are the common coloring matters, flavoring extracts, and preservatives. Among the most interesting results may be mentioned the discovery that peptic digestion is greatly retarded by picric acid, tropaeolin ooo, and metanil yellow, less so by salicylic acid and oil of wintergreen, and that

pancreatic digestion is retarded by Bismarck brown, cinnamon, and formol.

**The Amount and Properties of the Proteids of the Maize Kernel.** By THOMAS B. OSBORNE. *J. Am. Chem. Soc.*, 19, 525-532.—This is a continuation of the work of Chittenden and Osborne on the maize kernel. The article contains descriptions and analyses of the four fractions into which they had divided the proteid matter.

**The Caffein Compounds of Kola.** By J. W. T. KNOX AND A. B. PRESCOTT. *Pharm. Rev.*, 15, 172-176; 191-196.—The recent literature of oak tannins is considered at length, after which a description of the methods used in preparing the free kola tannin, and of some of its chemical properties, is given. The second part of the paper contains the results of analyses of the kola tannin, its bromine and acetyl derivatives, and its several anhydrides. The methods of preparation of these compounds and their properties are given.

**The Tannin of Castanopsis.** By HENRY TRIMBLE. *Am. J. Pharm.*, 69, 406-408.—This relates to the nature of the tannin in the bark of a group of trees intermediate between oaks and chestnuts in character. The tannin of the American *Quercus densiflora* and the *Castanopsis chrysophylla* of this group were shown to be identical with the oak tannin. As the chestnut tannin differs from these, and is identical with galltannin, the above intermediate group partakes of the nature of oaks. A table giving the analyses of ten of these barks accompanies the article.

**Aralia Nudicaulis.** By W. C. ALPERS AND B. J. MURRAY. *Am. J. Pharm.*, 69, 534-543.—This paper is a treatise on the wild sarsaparilla. Qualitative tests for tannin, sugar, alkaloids, etc., are described. Alkaloids and glucosides were not found. Tannin, starch, a volatile oil, and a resin were found. The results of a proximate quantitative analysis of the drug are given.

**The Important Constituents of Taraxacum Root.** By L. E. SAYRE. *Am. J. Pharm.*, 69, 543-546.—This portion of the author's continued work on *Taraxacum* is devoted to the bitter principle and to the analysis of the drug and of its ash.

**The Tannin of Ceriops Candolleana.** By HENRY TRIMBLE. *Am. J. Pharm.*, 69, 505-506.—This tree is common in India, being a small evergreen of the mangrove genus. Its bark is unusually rich in tannin, one dried sample containing 31.56 per cent. The tannin was shown to belong to the same class as the oak bark tannins.

**Some Products of the Tuberculosis Bacillus.** By E. A. DE SCHWEINITZ AND M. DORSET. *J. Am. Chem. Soc.*, 10, 782-785.—From bacillus cultures the authors have isolated a crystalline compound of melting-point 161°-164°. It is an acid soluble in ether, alcohol, and in water, and its analysis corresponds nearly to that of teraconic acid ( $C_6H_{10}O_4$ ). It is evidently that product of the tuberculosis germ which produces the necrosis peculiar to these bacilli.

**On the Presence of Amylolytic Ferment and Its Zymogen in the Salivary Gland.** By C. W. LATIMER AND J. W. WARREN. *J. Exptal. Medicine*, 2, 465-273.—Chloroform water and sodium fluoride solutions were used to extract the salivary glands of dogs, cats, rats, mice, oxen, sheep, and opossums. The extract was tested for amylolytic power; it was then acidified with acetic acid, and after ten minutes neutralized. The resulting solution was tested with starch paste for the zymogen. Many of the extracts contained the active ferment (ptyalin), many also the ptyalinogen, but no classification seems possible. No quantitative work was attempted.

**On the Presence of Milk-Curdling Ferment (Pixin) in the Gastric Mucous Membrane of Vertebrates.** By J. W. WARREN. *J. Exptal. Medicine*, 2, 476-492.—With chloroform water extracts the presence of a milk-curdling ferment in the stomachs of many vertebrates has been shown. This the writer calls pixin and its forerunner pixinogen. Active ferments were found by him in the extract from the ox and calf only. Fifty-three stomachs from thirteen different vertebrates gave pixinogen, which was made active as a ferment by acidification of the extract by acetic acid and subsequent neutralization.

**Note on the Influence of "Peptone" on the Clotting of Milk by Rennet.** By F. S. LOCKE. *J. Exptal. Medicine*, 2, 492-499.—The previous work on this subject has been done with peptones, having an alkaline reaction. To this alkalinity the author thinks the action of the peptone, in delaying the coagulation by rennet, should be ascribed, although attempts to obtain a peptone which did not cause this delay were futile.

**Algae and Antiseptics.** By R. H. TRUE. *Pharm. Rev.*, 15, 152-153.—This is practically a continuation of work done by Kahlenberg and True on the connection between the toxic action of acids, bases, and salts, and the condition of electrolytic dissociation of the agent. In this case the author has undertaken a study of the effects of acids and phenols upon the common spirogyra, and has determined the maximum dilutions fatal

to this algae. With hydrochloric and sulphuric acids this dilution was found to be 800 and 1600 liters per gram-molecule, respectively, which seems to confirm the opinion that the toxic action of the acids is to be accredited to the hydrogen ions. With hydrochinone the toxic power was greatly increased by the spontaneous alteration in this phenol in its dilute solutions. This is to be further investigated.

G. W. ROLFE, REVIEWER.

**The Distribution of Galactan.** By J. B. LINDSEY AND E. B. HOLLAND. *Mass. Agr. Coll. Ann. Rep.*, 34, 192-196.—The authors describe their method, which is that perfected by Tollen and others, based on the estimation of the derived mucic acid, and publish a large number of results, which show that galactan, while extensively distributed, is present in considerable quantity only in the leguminous plants. The greatest percentage was found in clover and lupin seeds, the amount in the latter exceeding 14 per cent.

#### SANITARY CHEMISTRY.

E. H. RICHARDS, REVIEWER.

**The Filtration of Water.** By EDMUND B. WESTON. *Municipal Eng.*, 13, 199-207.—The author considers the "American system of filtration" to be "mechanical filtration aided by the application of chemicals," in distinction from sand filtration, a process which was imported from Europe. He estimates the cost of the latter to be considerably more than that of the former, and questions the expediency of incurring this extra cost to obtain the increase of 1.5 per cent. of efficiency in the removal of bacteria which he concedes to the best European practice.

**Mechanical Filtration of the Public Water Supply of Lorain, Ohio.** By C. O. PROBST. *Ohio Sanitary Bull.*, 1, 100-120.—This report gives the conditions under which were made the tests of the Jewell filters, in purifying the water of Lake Erie, which is contaminated at the intake by the water from Black River. The results show that the use of 2.5 grams of alum per gallon and a rate of 100,000,000 gallons per acre per 24 hours appears to affect a sufficient purification.

**Milk: Its Value as a Food and Studies which Suggest a Different Method of Sale.** By E. B. VOORHEES AND C. B. LANE. *N. J. Agr. Sta. Bull.*, 123, 1-19.—The authors give the results of a year's study of the composition of the milk of a herd and of individual cows as affected by food and external conditions, and show that uniformity can be maintained, and suggest

that consumers should be educated to consider that a definite relation between price and food value can be established.

**The Composition of Prepared Cereal Foods.** By E. E. Slosson. *Wyoming Expt. Sta. Bull.*, 33, 71-84.—Analyses of twenty-one of the common "Breakfast Foods" are given. The results with thirteen preparations of wheat are shown in the following table:

	Fat. Per cent.	Protein. Per cent.	Calories per gram.	Cost.
Maximum .....	3.72	16.60	4689	15.8
Minimum.....	1.20	9.37	3993	4.3
Average.....	1.85	12.44	4215	9.5

The author concludes that "there is more variation in price than in composition." He might have added that the cost bore no relation to the food value or the palatability. In the six samples of preparations from oats, there is even less variation in composition, but more in price. Oatmeal, in bulk, is bought for 2.5 cents per pound, while 12.8 cents is paid for a brand very slightly richer. Another supposed advantage of the package foods is taken away by the author's statement "that the claims for quick cooking are generally fallacious."

**Soy Beans as Food for Man.** By C. F. LANGWORTHY. *U. S. Dept. Agr. Farmers' Bull.*, 58, 20-23.—In addition to a table giving nineteen selected analyses of the soy bean grown in different countries, the author describes ten modes of preparing it for food, mostly by fermentation, and gives the composition of the products. It is claimed that the soy bean contains no starch, and that when the cellulose is broken down by bacterial action, the nitrogen is well assimilated; it is also stated that these products replace meat in the Japanese dietary.

**Human Food Investigations.** By HARRY SNYDER. *Univ. Minn. Agr. Expt. Sta. Bull.*, 54, 37-90.—The author summarizes valuable work on the character and composition of the nitrogenous constituents of wheat as affecting the light porous loaf of the bread made from the different varieties, and shows that the prolonged fermentation of the dough causes certain losses in both the starchy and nitrogenous constituents. He does not, however, discuss the most important corollary: Is not the bread so much improved in flavor as to offset this small loss? Digestibility experiments were made with bread from whole wheat, bakers' flour, and patent spring wheat flour. The results showed that all were well assimilated. In the case of potatoes, the starch is the most perfectly digested, while the nitrogenous por-

tion is less available than in most vegetable substances. Experiments were also made in regard to the loss of food value by the different ways of cooking. Potatoes lose a large per cent. of the nitrogen when pared and soaked in cold water before cooking; but, as might have been predicted, very little of the starch is lost (except in the parings, which, however, may amount to 30 per cent. by weight, as has been determined repeatedly in the New England Kitchen). As the author has shown that the nitrogen is of small moment in the potato, one is puzzled to discover why so much stress is laid on this loss. The escape of the mineral salts is a more serious matter. The losses incurred in the cooking of carrots and cabbages are next considered, and shown to be very large, amounting to some 30 per cent. of the total food value, and the conclusion is that only by the use of the water in which the vegetables are cooked can all this value be recovered. The rest of the *Bulletin* gives in a concise form a summary of the main facts upon which the "*Rational Feeding of Men*" may be based. Tables of composition of food substances are reprinted from the *U. S. Dept. Agr. Bulletins*.

**The Value of a Bacteriological Examination of Water from a Sanitary Point of View.** By E. K. DUNHAM. *J. Am. Chem. Soc.*, 19, 591-605.—The author discusses both the methods of determining the presence of pathogenic forms of bacteria in potable water, and the interpretation of the results. He concludes that the method proposed is capable of giving information of value, especially when supplemented by the determination of the presence or absence of sufficient organic matter to furnish food for the continued growth of the organisms.

W. R. WHITNEY, REVIEWER.

**The Constitution of Milk with Special Reference to Cheese Production.** By S. M. BABCOCK. *Wis. Agr. Expt. Sta. Bull.*, 61, 1-21.—This is a comprehensive treatment of the subject, but it contains little that is really new.

**Tainted or Defective Milks: Their Causes and Methods of Prevention.** By H. L. RUSSEL. *Wis. Agr. Expt. Sta. Bull.*, 62, 1-27.—The sources of contamination are considered, the effects on the value of the milk for various purposes are pointed out, and methods for preventing or remedying the evils are suggested.

**Composition of Full Cream Cheese.** By WM. FEAR. *Pa. State College, School Agr., Bull.* 2, 1-16.—This paper summarizes experiments made in several states to determine the average composition of full cream cheese, and the variation in composi-

tion likely to arise from differences in the quality of the milk from which it is made. Briefly, the results are as follows: Green cheese of less than 32 per cent. fat is seldom produced from average factory milk; a green cheese loses about 5 per cent. in weight during one month's curing; and a reduction in the fat-content of the cheese is not likely to occur from the minor accidental variations in processes of manufacture or in differences of composition of unskimmed factory milk.

#### AGRICULTURAL CHEMISTRY.

W. R. WHITNEY, REVIEWER.

**On the Influence of Vegetable Mould on the Nitrogenous Content of Oats.** By H. W. WILEY. *J. Am. Chem. Soc.*, 19, 605-614.—The author concludes from the investigation of the effects of various soils on the composition of oats grown in them, that humus soils greatly increase the nitrogen content of the cereal, this increase being chiefly in amid nitrogen. Three forms of fertilizers employed on humus soils caused about an equal increase in the quantity and alteration of the quality of the crop.

**Physical Effects of Various Salts and Fertilizer Ingredients upon a Soil as Modifying the Factors which Control its Supply of Moisture.** By J. L. BEESON. *J. Am. Chem. Soc.*, 19, 620-649.—This article contains descriptions of apparatus and methods employed in studying, under varying conditions of composition, etc., the rate of percolation of water through soils, its evaporation from them, their water-holding capacity, and their rate of saturation.

**The Composition of Humus.** By HARRY SNYDER. *J. Am. Chem. Soc.*, 19, 738-744.—Analyses of different kinds of humus made by the decomposition in soils of various kinds of organic matter are given. The results make evident the fact that the chemical similarity between the different varieties is no greater than a consideration of their derivations would warrant; and they make necessary the indefinite postponement of an accurate chemical classification of these different forms of humus.

**A Study of Alfalfa and Some Other Hays.** By W. P. HEADDON. *Col. Agr. Expt. Sta. Bull.*, 39, 1-34.—This contains comparative analyses of alfalfa crops of different years and different cuttings of the same year, together with their relative digestibilities, as measured by acid pepsin solutions. Clover, pea vines, and upland hays are also subjected to the same methods of investigation. The results are well summarized on the concluding page, and the paper must be recognized as an important con-

tribution to our knowledge of fodders. The author's remarks concerning criticisms adverse to the class of investigations of which this paper is a good example, may have considerable significance in Colorado; but the value of scientific study in the comparatively fertile field of agricultural chemistry is elsewhere rapidly receiving the appreciation due to it.

**Burdock as a Vegetable.** By INAZO NITTOBE. *Am. J. Pharm.*, 69, 416-420.—The author discusses the use of the lappa or burdock root as an article of food and gives a table in which its composition is compared with that of other vegetables. In Japan, in 1888, about 36,000 tons of this root were produced for home consumption.

F. H. THORP, REVIEWER.

**Electrical Method of Determining the Moisture Content of Arable Soils. Electrical Method of Determining the Temperature of Soil. Electrical Method of Determining the Soluble Salt Content of Soil.** *U. S. Dept. Agr. (Division of Soils) Bull.*, 6, 7, 8.

**Fertilizers.** *Hatch Expt. Sta. Bull.*, 48; *Purdue Univ. Special Bull.*, May, 1897; *N. H. Agr. Expt. Sta. Bull.*, 43; *N. Y. Agr. Expt. Sta. Rep.*, 1895, 156-229; *N. Y. Agr. Expt. Sta. Bull.*, 116; *N. C. Agr. Expt. Sta. Bull.*, 136.

**Some Notes Concerning the Nitrogen Content of Soils and Humus.** By E. FULMER. *Wash. Agr. Expt. Sta. Bull.*, 23.—This bulletin contains determinations of nitrogen, phosphoric acid, potash, lime, iron oxide, and organic matter, in 53 soil samples.

G. W. ROLFE, REVIEWER.

**Sugar Beets.** By W. W. COOKE AND WILLIAM P. HEADDON. *Col. State Agr. Coll. Bull.*, 36, 1-23.

**A Review of Oregon Sugar Beets.** By G. W. SHAW. *Ore. Agr. Expt. Sta. Bull.*, 44, 1-49.—These bulletins are excellent examples of the work which many of the official experiment stations are doing out of deference to a generally awakened interest in the possibilities of beet sugar manufactured in this country. The experimental results of the investigations on the production and yield of the sugar beet in Colorado and Oregon are, as far as they go, favorable to the industry. Both reports give much practical information of a general nature as to cultivation. The Oregon report also goes into the manufacture and cost of production of the sugar, and will doubtless be of value in correcting the fallacious ideas so prevalent as to the conditions requisite for success from a business standpoint.

## ANALYTICAL CHEMISTRY.

### PROXIMATE ANALYSIS.

A. H. GILL, REVIEWER.

**The Detection of Foreign Fats in Lard and Butter.** By C. B. COCHRAN. *J. Am. Chem. Soc.*, 19, 796-799.—Two cubic centimeters of the melted fat are introduced into 22 cc. of fusel oil contained in a glass-stoppered graduate, and the mixture is warmed to about 40° C. and allowed to cool slowly to 16° or 17° C. for two or three hours. A crystalline deposit forms, which is filtered off, recrystallized from ether, and examined microscopically. The method is capable of detecting five per cent. of beef fat. The amount of deposit which is formed and the melting-point of the sample may furnish a basis of estimation of the quantity of admixture.

**Volatile Oils and Their Assay.** By E. KREMERS. *Pharm. Rev.*, 15, 196-198.—The article is an introductory one dealing with the changes produced in the oils upon standing and by distillation.

**Notes on Several Fatty Oils.** By F. A. SIEKER. *Pharm. Rev.*, 15, 112-113.—The oils described are those of the Saw palmetto, pumpkin seed, and croton oil. Saw palmetto oil is soluble in alcohol as well as ether and petroleum ether; it has a specific gravity of 0.9138 at 15° C., and a cold test of 14°. The iodine value is 42-43, and the saponification numbers are 212.5 to 217; it does not solidify when subjected to elaidin test. Pumpkin seed oil is of a reddish-yellow color, soluble in ether, petroleum ether, and carbon disulphide, but insoluble in alcohol. Its specific gravity is 0.9231 at 15° C.; its iodine value, 118-119; and its saponification number 195. It is not solidified by the elaidin test. Croton oil is of a yellow color and is soluble in the usual solvents. Its specific gravity at 15° C. is 0.9445; its iodine value, 107-108; and its saponification number, 192-196.

**The Chemistry of Food Adulteration.** By HENRY LEFFMANN. *J. Franklin Inst.*, 144, 133-137.—This paper is an abstract of an address on the methods of expressing analytical results in food analysis.

G. W. ROLFE, REVIEWER.

**The Exact Estimation of Total Carbohydrates in Acid Hydrolyzed Starch Products.** By GEO. W. ROLFE AND W. A. FAXON. *J. Am. Chem. Soc.*, 19, 698-703.—The authors compute by a graphical method from the specific gravity factors

for hydrolyzed starch products of all possible specific rotatory powers. The actual specific gravity factors of sixteen hydrolyzed starch samples were obtained by evaporation to dryness, by method of Lobray de Bruyn and Van Laent. They were found as a whole to agree closely with the calculated values. A formula is given by which the total carbohydrates in any solution of the kind can be quickly estimated, when the specific rotatory power, obtained by the factor 386, is known.

**The Phloroglucin Method for the Estimation of Pentsoans.**

By J. B. LINDSEY AND E. B. HOLLAND. *Mass. Agr. College Ann. Rep.*, 34, 197-199.—The authors describe the method devised by Councler and perfected by Kruger and Tollens, and give six determinations of seeds and fodders, together with six parallel determinations by the usual phenyl hydrazin method. The results are concordant, and the authors recommend the phloroglucin process on account of its greater simplicity.

F. H. THORP, REVIEWER.

**A Comparison of the Methods for Determination of Glycerol. With Notes on the Standardizing of Sodium Thiosulphate.** By W. E. GARRIGUES. *Proc. Eng. Soc. Western Pa.*, 13, 271.—Minute directions are given for the three standard methods of analyzing spent soap lyes, with certain modifications, by the author. The processes examined were (*a*) Benedikt and Zsigmondy's oxidation process, with alkaline permanganate; (*b*) Benedikt and Cantor's acetin process; (*c*) Hehner's oxidation process with acid bichromate solution. The author concludes that crude glycerol is best determined by the acetin process, and soap lyes by the bichromate method. The proper conditions must be observed in standardizing the thiosulphate and in determining chromic acid; the process recommended is as follows: 25 cc. of chromic acid solution are mixed with 10 cc. of a ten per cent. potassium iodide solution and five cc. of strong hydrochloric acid. Let the mixture stand ten minutes and then dilute with 150 cc. of water, and titrate the iodine, stoppering and shaking violently between the addition of the last few drops of thiosulphate, to dissolve any iodine in the precipitated iodide of starch. This is essential to accurate work. There is no benefit to be obtained in using lead acetate with lyes or crude glycerine, since the sulphuric acid is sufficient to clarify them. But in candle glycerine, a little lead may be used to precipitate organic matter.

**Asphalt Examination.** By H. ENDEMANN. *Municipal Eng.*, 13, 6.—This is a short article on a method of analysis proposed by the author for the separation of petrolene and

asphaltene. A number of analyses are given; and a method of calculating the amounts of asphalts of different quality, which must be combined to produce a standard grade is fully explained.

**Determination of Potash and Phosphoric Acid in Fodders.**  
By H. W. WILEY. *J. Am. Chem. Soc.*, 19, 320-322.—This article describes an improvement on the usual method, whereby time is saved.

W. R. WHITNEY, REVIEWER.

**The Rapid Estimation of Uric Acid in Urine.** By E. H. BARTLEY. *J. Am. Chem. Soc.*, 19, 649-656.—After a comprehensive review of many methods employed for uric acid determination, the author describes one of his own. This consists of a titration with silver nitrate solution in the warmed urine after the addition of ammonium and magnesia mixture. The endpoint is determined by testing a drop of the solution for silver by sodium sulphide, from time to time, during the titration. Comparative results obtained by Ludwig's and by the author's method are given.

## APPARATUS.

A. H. GILL, REVIEWER.

**A Recent Assay Balance.** By L. S. AUSTIN. *Proc. Col. Sci. Soc.*, 1897, 1-6.—The article describes what would seem to be an unusually delicate balance.

**Some New Forms of Apparatus.** By A. E. KNORR. *J. Am. Chem. Soc.*, 19, 817.

**An Electrical Laboratory Stove.** By M. D. SOHON. *J. Am. Chem. Soc.*, 19, 790.

**Mechanical Arrangement for Fat Extraction Apparatus.** By G. J. VOLCKENING. *J. Am. Chem. Soc.*, 19, 735.

**Method of Drying Sensitive Organic Substances.** By C. C. PARSONS. *J. Am. Chem. Soc.*, 19, 388.

**A New Form of Condenser for the Distillation of Liquids having Low Boiling-Points.** By E. E. EWELL. *J. Am. Chem. Soc.*, 19, 398.

**A New Apparatus for Sulphur Determinations in Iron and Steel, and a Useful Form of Wash-Bottle.** By R. K. MEADE. *J. Am. Chem. Soc.*, 19, 581.

**A Simple Fat Extractor.** By V. J. HALL. *J. Am. Chem. Soc.*, 19, 586.

**An Apparatus for Collecting Samples of Water.** By GEORGE C. WHIPPLE. *Eng. Record*, 35, 515.—The apparatus is designed to collect water from considerable depths. For the method of operation reference must be made to the original article.

**A Simple and Efficient Boiling-Point Apparatus for Use with Low- and with High-Boiling Solvents.** By HARRY C. JONES. *Am. Chem. J.*, 19, 581–597.—The author discusses the various forms of apparatus in use, and suggests a modification of Hite's apparatus, in which the condensed solvent is not returned directly into the boiling solution. The apparatus consists of a tube about one-fourth filled with glass beads, on which rests a platinum cylinder. The thermometer is immersed in the solvent inside the cylinder, which serves to separate the condensed solvent and boiling solution. The results obtained seem to be very satisfactory.

## METALLURGICAL CHEMISTRY.

H. O. HOFMANN, REVIEWER.

**Ferric Sulphate in Mine Waters and Its Action upon Metals.** By L. J. W. JONES. *Proc. Col. Sci. Soc.*, June 15, 1897.—The author analyzed a muddy mine water, which strongly corroded the pumps and other iron parts. The filtered mud gave:  $\text{Fe}_2\text{O}_3$ , 53.57;  $\text{Al}_2\text{O}_3$ , 2.87;  $\text{SiO}_2$ , 10.85;  $\text{SO}_4$ , 11.46;  $\text{H}_2\text{O}$ , 21.14. The filtered water in 1,000 parts:  $\text{SiO}_2$ , 0.043800;  $\text{NaCl}$ , 0.013450;  $\text{Na}_2\text{SO}_4$ , 0.311720;  $\text{K}_2\text{SO}_4$ , 0.155480;  $\text{Al}_2(\text{SO}_4)_3$ , 0.019787;  $\text{ZnSO}_4$ , 0.122440;  $\text{MnSO}_4$ , 0.427140;  $\text{MgSO}_4$ , 0.467460;  $\text{CaSO}_4$ , 0.636290;  $\text{Fe}_2(\text{SO}_4)_3$ , 0.603360;  $\text{FeSO}_4$ , 0.009337;  $\text{CuSO}_4$ , 0.1918010; total, 3.002065. Free sulphuric acid was absent; the corrosive action on iron was due, in part, to cupric sulphate, and the solvent power for copper to ferric sulphate. As a result of a number of experiments, bronze pipe was used in the mine and this has stood for over two years.

**Composition and Formation of Tank Residues in Electrolytic Refineries.** By E. KELLER. *J. Am. Chem. Soc.*, 19, 778–782.—The author compares the composition of anode copper with that of the tank residues obtained during a given time at one of the leading electrolytic copper refineries of the country, and draws deductions as to the degree of concentration of silver (gold) in the residue, and the amount of the original contents of the anodes which went into solution and remained in the

residue. He also calls attention to the fact that selenium is present in Montana coppers to a much greater extent than is generally believed.

**Practical Workings of Chlorination.** By T. G. TAYLOR. *Min. Sci. Press*, 75, 48.—The article is a description of the work done at the Champion mine, Nevada City, Cal.

**Apparatus for Extracting Gold and Silver from Ores by the Cyanide Process.** By A. S. COOPER. *Min. Sci. Press*, 74, 542-543.—A sheet-iron conical drum, closed at both ends and having spiral blades, revolves on a horizontal axis. It receives ores and solutions at the larger end and discharges them at the smaller one.

**Notes on the Action of Potassium Zinc Cyanide Solutions on Gold.** By W. J. SHARWOOD. *Eng. Min. J.*, 64, 396, 426, 460, 461.—The author gives a summary of what has been published on the subject with all the necessary references, discusses the value of the different equations proposed from a thermochemical point of view, and describes in detail his own experiments, embodying over two hundred and fifty observations, to which the reader is referred for details. The conclusions arrived at are: (1) The gold-dissolving power of a solution of potassium zinc cyanide increases rapidly with increased excess of oxygen, presence of oxygen being the most essential condition. (2) It increases somewhat with strength of solution, but this effect is small. (3) It increases with a rise of temperature. (4) Gold dissolves in the solutions without forming any precipitate at first, but after a certain proportion of gold has dissolved, a white precipitate begins and continues to form, gradually coating the metal and retarding further action. The amount of precipitate is not proportional to that of the gold dissolved, being relatively less when the amount of solvent is large; it consists of a somewhat variable mixture of cyanide and oxide of zinc. (5) The solvent action of the double cyanide solution is less than that of a solution of simple potassium cyanide containing the same amount, or half the amount, of cyanogen in equal volumes. (6) It is increased by addition of caustic alkali, other conditions remaining the same, and the increase is greatest in solutions to which oxygen has the freest access. (7) The considerable increase in solvent power observed when caustic potash is added (always provided that oxygen is accessible), coupled with the superior effect of free potassium cyanide, is good evidence that some free potassium cyanide is formed upon such addition, and, therefore, that in dilute solutions (such as 0.3 to 0.6 per cent. or 0.80 to 0.40 gram molecule per liter)

potassium zinc cyanide is partially decomposed by caustic alkali, in accordance with the principles of chemical equilibrium between substances in solution.

**Cyanide Mill Solutions.** By PH. ARGALL. *Eng. Min. J.*, 64, 393.—This note is a correction of a typographical error in a previous paper (*this Rev.*, 3, 139). In the table there given, in place of : KCy 0.501, 0.451, 0.535, 0.410; read KCy 0.501, 0.491, 0.505, 0.505.

**The Edison Concentrating Works.** By C. KIRCKHOFF. *Iron Age*, No. 18, 60, 1-8.—The larger part of this paper is an illustrated description of the magnetic concentration plant of Edison at the Ogden Mines, N. J. The magnetite concentrates are converted into briquettes containing : Fe 67-68, SiO<sub>2</sub> 2-3, Al<sub>2</sub>O<sub>3</sub> 0.4-0.8, Mn 0.05-0.10, CaO, MgO, S traces, P 0.028-0.033, resinous binder 0.78, H<sub>2</sub>O none. In trial runs made in the blast furnace of the Crane Works, Catasauqua, Pa., the normal product of 100-110 tons of pig was increased to 138.5 tons. This was due to the richness of the ore, which, however, caused not only an increased output of pig but a decrease in the amount of limestone required and a larger number of charges. It was also found that the fuel consumption was lowered. The following analyses give the character of the pig produced :

Date.	Percentage briquette on charge.	Tons produced.	Si.	P.	S.	Mn.
Jan. 5 ....	25	104	2.750	0.830	0.018	0.500
" 6 ....	37.5	124.5	2.620	0.740	0.018	0.350
" 7 ....	50	138.5	2.572	0.580	0.015	0.200
" 8 ....	75	119	1.844	0.264	0.022	0.200
" 9 ....	100	138.5	1.712	0.147	0.038	0.185

**The Value of Physical Tests.** By S. S. KNIGHT. *Am. Manufacturer*, 61, 585-586.—The paper is a strong plea that chemical work in the iron foundry shall be on the same footing with physical testing, which is so frequently made the sole standard. In his arguments the author brings forward several facts of general interest. He shows by analyses and physical tests that the adage "the shrinkage in iron varies inversely as the silicon" is absolutely wrong, the fact being that it varies directly as the sulphur, manganese, combined carbon and titanium and inversely as the silicon and phosphorus. How absolutely necessary chemical work is in a foundry is illustrated by an interesting set of determinations, showing that the first tap of a day from the cupola was uniformly softer than that of any others made later during the day ; e. g. : Silicon in metal from first tap was 2.739, 2.891, 2.624 per cent., and from the fourth tap, 2.102, 2.007, 1.992 per cent.

**A Preliminary Thermo-Chemical Study of Iron and Steel.** By E. D. CAMPBELL AND F. THOMPSON. *J. Am. Chem. Soc.*, 19, 754-766.—This paper comprises the results obtained by the authors in trying to determine whether carbon was the sole cause for the variations in the heat of solution of steels subjected to different heat treatments. They summarize the work done by Troost and Hautefeuille in 1875, and Osmond in 1885, and give the results of their own work, which is brought together in four tables representing the influence on the heat of solution of chemical composition, annealing, quenching, tempering, and reheating, and of reheating on the tensile strength of cold-drawn wire.

**Semi-Steel.** By C. KIRCKHOFF. *Iron Age*, No. 3, 60, 13.—The basis of this metal is a low-carbon steel to which are added special irons which make the product homogeneous, solid, strong, and tough. It has twice the strength and elasticity of cast iron, can be used in seventy-five per cent. of the work for which steel castings are commonly used, and costs about half the price.

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### ASSAYING.

H. O. HOFMAN, REVIEWER.

**A Modified Method of Fine Silver Assay.** By A. E. KNORR. *J. Am. Chem. Soc.*, 19, 814-816.—The author has combined the Gay-Lussac and Volhard methods of assaying fine silver, by precipitating the bulk of the silver with a standard salt solution in the usual way and finishing the assay with potassium sulphocyanate, of which 1 cc. will precipitate 1 mg. silver. As indicator he uses 5 cc. of a solution of ferric ammonic alum.

**Assaying Gold and Silver.** By J. B. ECKFELDT. *Min. Sci. Press*, 75, 4, 29, 49.—These articles give an outline of the modes of procedure at the United States Mint at Philadelphia.

# Review of American Chemical Research.

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